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Fig. 1. *1*, A portion of the jejunum showing eight diverticula. The mesenteric vessels are seen branching over their walls. (One-half natural size.) *2*, A portion of the opened jejunum showing the valvulæ conniventes and four stomata leading into diverticula. (One-half natural size.) *3*, Vertical section of one of the smaller diverticula. This diverticulum is funnel shaped. At its apex is seen a large thick-walled blood vessel. The attenuated tunica muscularis of the intestine is intact, except at the apex of the diverticulum where it has been replaced by connective tissue. (×5.) *4*, Vertical section of one of the larger diverticula. There is no evidence of muscular tissue in the wall of the sac. A dense connective-tissue envelop (thickened tela submucosa) acts as a support to the tunica mucosa. A large blood vessel is seen [illegible] of the sac at the mesenteric attachment. (×5.)

False Diverticula of the Jejunum.—Frank H. Helvestine, Jr.

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FALSE DIVERTICULA OF THE JEJUNUM

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DIVERTICULA occur in the jejunum and ileum less frequently than in any other portion of the intestinal tract. Only 27 cases of jejunal diverticulosis have been reported in the literature. A diverticulum the wall of which contains all of the intestinal coats is classed as a true diverticulum. It is distinguished from a false diverticulum which usually has no muscularis in its wall. A distinction is also made between those diverticula which occur as congenital anomalies and those which are acquired in later life. In the majority of cases of jejunal diverticulosis, the diverticula are of the false type. They occur most frequently along the mesenteric border of the intestine and are related to the mesenteric vessels. Most of the cases observed have been in old individuals.

Many theories have been advanced to explain the occurrence of these diverticula. Klebs (1869) supposed that traction on the intestine by the mesentery is the etiological factor. Hansemann (1896) claimed that intra-intestinal pressure, from the accumulation of gas or fæcal material, causes the diverticula. The theory that venous congestion causes separation of the muscle bundles, with subsequent herniation of the mucosa, was advanced by Graser (1899). Roth (1872) mentions fatty degeneration of the tunica muscularis as a possible cause. Sudsuki (1900) regards a diminished resistance of the connective tissue about the veins as a predisposing factor.

It is the purpose of this investigation to describe two cases of false diverticula of the jejunum, and to consider the etiological factors involved in this condition. A consideration of these cases, together with those described in the literature, discloses three factors operating conjointly in the formation of acquired diverticula: (1) traction by the mesenteric vessels or traction following adhesions, (2) degeneration of the intestinal musculature, and (3) intra-abdominal pressure. Acquired diverticula develop first as true diverticula but later lose their muscular coat and become false diverticula.

CASE REPORTS

University of Virginia, Necropsy No. 489

CASE 1. *Clinical note.* The patient, a white man, age 70, came to the University Hospital complaining of frequency of urination, tenesmus, and chills and fever. A diagnosis of hypertrophy of the prostate was made. The illness of the patient on admission was so serious that very little could be done for him and on September 29, 1922, he died with symptoms of uræmia.

Necropsy note. The body is that of an emaciated white man of advanced years. The skin has an intense yellow color and the subcutaneous fat is orange yellow. The prostate, especially the middle lobe, is greatly enlarged. The wall of the bladder is much thickened, and at the fundus is a small diverticulum. This diverticulum is a small sac-like structure about 2 centimeters in diameter. The stoma opening from the bladder into the diverticulum is about 1.5 centimeters in diameter. The kidneys are small and show the changes of chronic

nephritis. The mitral valves are sclerosed and calcified. The mitral orifice is stenosed, and there is brown atrophy of the cardiac muscle. The arteries are markedly sclerosed, and nearly the entire length of the aorta is calcified. The liver shows a moderate degree of cirrhosis. The connective-tissue elements of the spleen are increased. The lungs are emphysematous, and there is a mucopurulent bronchitis.

Beginning at the duodenojejunal junction, and occurring throughout the first 95 centimeters of the length of the jejunum, are fifty-eight separate and distinct diverticula. These diverticula are small pouches varying in size from 2.5 by 2 centimeters to 0.5 by 0.3 centimeters. They arise along the mesenteric border of the jejunum and lie either on one side or the other of the mesentery. They are covered by serosa and appear to arise where the mesenteric vessels enter the gut wall. Blood vessels are seen coursing over their surface. The large diverticula are seen near the duodenum, and they are progressively smaller the farther they are from the duodenum. The larger pouches are spheroidal, saccular structures, while the smaller ones are funnel-shaped (Fig. 1, *1*). The stomata which connect the diverticula with the intestinal lumen are much smaller than the cavity of the diverticula (Fig. 1, *2* and Fig. 2). Vertical sections of these structures show that their wall is much thinner than the intestinal wall. (For Fig. 1—*1*, *2*, *3*, and *4*—see frontispiece.)

Microscopically, the intestine, at a point where no diverticula appear, shows a marked alteration of the tunica muscularis. The inner circular layer of muscle, which is normally much thicker than the longitudinal layer, is very much thinned and appears to be only about half as thick as the longitudinal muscle. The muscularis mucosa is almost entirely absent.

The smaller funnel-shaped diverticula are seen to have walls composed of mucosa, submucosa, and muscularis, except at the apex of these diverticula where there is no muscular covering (Fig. 1, *3*). At this point the muscle layers have disappeared and have been replaced by connective tissue. There is a large thick-walled blood vessel at the apex of the diverticulum.

This large saccular diverticula have no muscle fibers in their walls (Fig. 1, *4*). The muscular layers of the intestine end abruptly at the stomata of the diverticula. There is a dense connective-tissue envelop which acts as a supporting element for the mucosa of the diverticula. In the wall, and to one side of the sac, is a large thick-walled blood vessel. The mucous membrane lining these diverticula has the same appearance as that lining the intestine.

University of Virginia, Necropsy No. 497

Case 2. *Clinical note.* The patient, a white woman, age 59, entered the University of Virginia Hospital, November 6, 1922, with a ruptured gall bladder. She was immediately operated upon and the gall bladder drained. Peritonitis followed and the patient died November 25, 1922.

Necropsy note. The body is that of an obese white woman of advanced years. There is an incision in the right upper quadrant from which protrudes several pieces of gauze drain. Permission is obtained only to enlarge this incision slightly and only the liver and a small portion of intestine are removed. The intestines are bound to the anterior abdominal wall and the loops are bound together by easily separable adhesions. There are pockets of purulent fluid formed between the loops of intestines and the anterior abdominal wall. There is pus in the lesser peritoneal cavity. There are no signs of intestinal obstruction. The spleen presents the picture of acute splenic tumor. The liver appears normal but the gall bladder is shrunken, and there is a perforation at its fundus.

Situated about 20 centimeters from the duodenojejunal junction there is a solitary diverticulum of the jejunum. This diverticulum is on the opposite side of the gut from the mesentery. The sac is about as large as a small hen's egg and its circular stoma, which opens into the lumen of the intestine, measures 2 centimeters in diameter. A little to one side of the fundus of this diverticulum is a dense, fibrous adhesion which is attached to the anterior abdominal wall. The diverticulum is of the false type. The proximity of this diverticulum to the duodenum would rule out the possibility of it being a Meckel's diverticulum.

REVIEW OF LITERATURE

In Table I, I have summarized 27 cases of diverticula of the jejunum reported in the literature.

This table shows that the average age at which jejunal diverticula have been observed

TABLE I.—SUMMARY OF TWENTY-SEVEN CASES REPORTED IN THE LITERATURE

Case	Observer	Year	Sex	Age in Years	Number of Diverticula	Position	Type
1	Cooper	1844	Male	50	Multiple	Mesenteric	False
2	Cornillon	1869	Female	30	1	Mesenteric	False
3	Neumann	1870	Male	65	1	(?)	True
4	Osler	1881	Male	65	53	Mesenteric	False
5	Moore	1883	Male	40	3	Mesenteric	True
6	Buzzi	1885	Male	77	1	Mesenteric	True
7	Buchwald and Janicke	1887	Male	6	1	Mesenteric	True
8	Virchow	1890	Male	Old	Multiple	Mesenteric	False
9	Edel	1894	Female	73	7	Mesenteric	(?)
10	Seippel	1895	(?)	(?)	Multiple	Mesenteric	False
11	Good	1895	Female	77	6	Mesenteric	False
12	Hansemann	1896	Male	14	1	Opposite mesentery	(?)
13	Hansemann	1896	Male	85	400	Mesenteric	False
14	Grassberger	1897	Male	73	1	Mesenteric	False
15	Nichols	1899	Female	64	15	Mesenteric	False
16	Hodenpyl	1900	(?)	(?)	Multiple	Mesenteric	False
17	Fischer	1901	(?)	(?)	1	Mesenteric	False
18	Gordinier and Sampson	1905	Female	46	13	Mesenteric	(?)
19	Taylor and Lakin	1910	Female	68	Multiple	Mesenteric	False
20	Balfour	1913	Male	62	4	Mesenteric	(?)
21	Latarjet and Murad	1914	Female	50	1	Mesenteric	False
22	Braithwaite	1918	Male	45	60	Mesenteric	(?)
23	Case	1920	Male	61	12	Mesenteric	False
24	Case	1920	Male	73	25	(?)	(?)
25	McWilliams	1921	Male	71	7	Mesenteric	(?)
26	Terry and Mugler	1921	Female	59	5	Mesenteric	False
27	MacKechnie	1921	Female	43	13	Mesenteric	False

is 56 years. If the case of Hansemann (1896), in which diverticula occurred in a boy of 14 years, and that reported by Buchwald and Janicke (1887), in which they occurred in a boy of 6 years, had been eliminated from the series, the age incidence would have been much higher.

With one exception the diverticula have been found along the mesenteric border of the gut in the cases reported. The large majority of the diverticula found in the jejunum have been of the false type. Rokitansky (1856), Hansemann, and others have described the false diverticula as hernia of the mucosa and submucosa through the muscular wall.

Klebs (1869) was the first to notice that there was a definite relation between the mesenteric vessels and those diverticula which occur on the mesenteric side of the intestine. He observed that the diverticula occur at points where the vessels enter the gut wall. Subsequent investigators have fully confirmed this observation. Upon the basis of this observation, Klebs advanced his theory of traction to explain the cause of the occurrence of these diverticula. He thought that either

Fig. 2. Roentgenogram of a portion of the jejunum, injected with bismuth paste, showing seven diverticula of various sizes. The stomata of these diverticula are very much smaller than the sacs

excessive growth of the mesentery relative to that of the blood vessels, or in later life traction upon the mesentery by the intestine, cause the funnel-shaped areas of attachment to be converted into diverticula.

Hansemann and Graser (1899) have pointed out that when diverticula form they follow the sheath of one of the intestinal veins. Graser claimed that the veins became enlarged through congestion and in consequence pushed the muscle fibers apart. Subsequently, when this congestion was relieved, the channel occupied by the engorged veins was not completely filled up and thus offered a point of lowered resistance through which the intestinal mucosa could herniate. Sudsuki (1900) found that only a portion of his cases showed venous congestion. He suggested that degeneration of the connective-tissue fibers of the venous sheath formed a path of lowered resistance through which a hernia of the mucosa might be formed. Roth (1872) thought that fatty degeneration of the muscularis was the predisposing cause of the diverticula.

Hansemann claimed that intra-intestinal pressure, caused by accumulation of gas or fæces, might be the cause of intestinal diverticulosis. By experiments with gut removed from the cadaver in which he caused internal pressure by filling the intestines with water under pressure, Hansemann was able to produce diverticula very similar to those observed in his necropsy. Chlumsky (1899) in repeating the experiments of Hansemann and others, but using the live intestines of a dog instead of the dead gut as had Hansemann found that, contrary to the experience of the other investigators, rupture always occurred on the side opposite to the mesentery.

Most of the cases of jejunal diverticula reported in the literature have been observed at necropsies. In the last few years, with the advent of the roentgen rays and a better understanding of intestinal diverticulosis, the condition has been more often recognized clinically and at operation. Diverticula of the jejunum usually produce no symptoms. Several cases have been reported, however, in which the condition gave rise to serious complications. In the case reported by Gordinier and Sampson (1906) one of the diverticula had become inflamed, and a diverticulitis resulted with partial obliteration of the lumen of the intestine. A resulting localized peritonitis caused the formation of adhesions, with a subsequent kinking of the intestine and obstruction. Case (1920) reported a case diagnosed by X-ray examination which showed an inflammation of a large diverticulum. Terry and Mugler (1921) operated on a woman for intestinal obstruction due to an enterolith lodged in a diverticulum.

Diverticulosis has been treated operatively by resection of a portion of the gut or by inverting the sac into the lumen of the gut when this was possible.

DISCUSSION

False diverticula of the intestine occur almost exclusively in old individuals. Case noted the correlation between intestinal diverticulosis and the occurrence of diverticula of the urinary bladder. One of the cases here considered had a diverticulum at the fundus of the bladder, and a greatly hypertrophied prostate. Several of the cases reported had inguinal and femoral herniæ. Constipation is commonly associated with intestinal diverticulosis.

Rectal or vesical straining due to constipation or retention of urine would cause an increased intra-abdominal pressure. Coughing due to bronchial irritation would also have the same effect. This pressure would be intermittent, and would reach a maximum suddenly. Such a sudden pressure upon a full section of intestine would be much more efficient in causing a protrusion of the gut wall at a weakened point than the gradual increase in pressure inside of the intestine consequent upon the slow accumulation of gases or fæcal material, which would allow the intestine, through distention, to adapt itself to this pressure. The high degree of distensibility of the intestines is seen in cases of intestinal obstruction. The action of intra-abdominal pressure upon a full section of gut would be comparable to squeezing upon a toy balloon with the hands. The balloon would protrude in the spaces between the fingers. The relatively inelastic muscular coat of the intestine would correspond to the fingers and any point of lowered resistance of the intestinal wall would correspond to the spaces between the fingers. Intra-abdominal, rather than intra-intestinal, pressure, as claimed by Hansemann, is probably an important force in producing diverticula.

Normally the inner circular muscle layer of the jejunum is thicker than the longitudinal layer. Microscopic examination of the jejunum in this case, at a point where no diverticulum is present, shows that the longitudinal layer is much thicker than the circular muscle. The circular muscular layer is atrophied and thinned. With such a weakened condition of the gut wall, traction by the shortened sclerosed mesenteric vessels is probably, as Klebs believed, the initial cause of the formation of diverticula on the mesenteric border of the gut.

Such diverticula in the beginning of their formation are of the true type, containing all the coats of the intestinal wall as is the case in the smallest pockets found in my specimen and in the specimen described by Klebs. Later, probably due to progressive atrophy, now accelerated by increased pressure from within, the muscle fibers disappear and a larger diverticulum of the false type is formed.

Traction by the mesenteric vessels would not, however, explain the occurrence of the diverticula elsewhere than on the mesenteric side of the intestines. The other two factors, muscular atrophy and intra-abdominal pressure, would act the same in both cases of acquired diverticula. In Hansemann's case, in which a diverticulum occurred on the side of the intestine opposite the mesentery, traction by an accessory pancreas was considered the causative factor. Neumann (1870) reported

a similar case. Adhesions and tumors have also been described as being an initial etiological factor in these cases. In one of my cases a dense adhesion was the primary cause of the formation. Doubtless a number of these cases are congenital.

SUMMARY

1. Acquired diverticula of the jejunum occur relatively rarely. Most cases are seen in old individuals. The diverticula in the majority of cases are of the false type and occur along the mesenteric border of the intestine. There is a definite spatial relation between the mesenteric vessels and the diverticula.

2. Intra-abdominal pressure, caused by rectal or vesical tenesmus, is perhaps the force causing the development of diverticula. Atrophy of the intestinal muscle, especially the inner circular layer, is a predisposing factor in the formation of the diverticula. Local traction upon the gut by adhesion or by the mesenteric vessels when shortened following sclerosis, is probably the initial cause of the formation of these diverticula in my cases.

3. Acquired diverticula, in the earliest stages of formation, are of the true type, and may continue to develop as true diverticula. In the majority of cases, however, the muscle fibers disappear by degeneration, and the diverticula develop as false diverticula.

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DIVERTICULUM OF THE DUODENUM

With Report of a Case in which the Diverticulum was Imbedded in the Head of the Pancreas, and a Method for its Removal[1]

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THE object of this communication is to draw attention to the unusual condition of duodenal diverticulitis, and to put on record the history of a case, associated with chronic hypertrophic pancreatitis, with symptoms simulating those of severe biliary colic.

Diverticulum of the duodenum is a rare condition. Diverticulitis duodeni is even more rare. In other words, the proportion of duodenal pouches subject to inflammatory attacks, thus causing symptoms, is extremely small. Cases causing clinical manifestations have recently been recorded by Ernest K. Cullen, Dean Lewis, Walter M. Jones, and others, and many interesting articles have been written on the subject.

The condition was first described by Chomel (1), in 1710, though priority had been accredited to Morgagni. Baldwin (2), in a series of 105 necropsies, found 14 cases of duodenal diverticula, and yet the literature shows no cases diagnosed prior to operation before 1912. E. Wyllys Andrews in a communication read before the surgical section of the American Medical Association, June, 1921, gave an epitome of what had been written on the subject. The history has also been reviewed by Edmund J. Spriggs in an article in the *British Journal of Surgery*, July, 1920. Even up to the early part of the present century this condition was regarded more as an anatomical and pathological curiosity than as a clinical entity. It is only during the last decade, with the increasing efficiency of the X-ray, that the condition has been observed and studied more frequently, and has reached a place where it must be considered in the differential diagnosis of diseases of the upper abdomen.

The importance of a careful study of diverticula of the duodenum may be inferred from the ratio of their occurrence, when compared with that of diverticula in other parts of the intestinal tract. Case (3), in a very important and exhaustive article on the subject, gives the proportions in his own series of 6,847 consecutive barium meal studies as follows: duodenal diverticulosis, 85 cases, or 1.2 per cent; jejunum and ileum (other than Meckel's diverticula), 5 cases, or less than 0.1 per cent, and in the large bowel, 138 cases, or approximately 2 per cent.

EMBRYOLOGY

Lewis and Thyng (4) found numerous epithelial outgrowths in the embryo along the whole length of the intestinal tract, but especially in the duodenojejunal part. These outgrowths, which gradually disappear, were similar in nature to the buds, which give rise to the pancreas. They further found that in the pig embryos from 5.5 to 14 millimeters in length, one or two knob-like diverticula occur regularly in the duodenal region. In still larger embryos, they found diverticula occurring in increasing numbers along the small intestine, not appearing in the colon. These unexplained embryological observations do not seem to have been given the place of importance that they merit in the discussion of the etiology of intestinal diverticula.

Hansemann records a case where 400 intestinal diverticula were found, and Osler (5) also reported a case, in which the jejunum presented fifty-three. Others have observed diverticula in infants at birth. These cases strongly suggest a direct relationship between the above embryological observations and diverticula of the small intestine.

In 1899 Letulle (6) described two cases in each of which he noticed a small pouch in close proximity to the papilla of Vater, and thought that these were to be explained as congenital anomalies of development due to the budding out from the duodenum of processes, as in the formation of the liver and pancreas.

[1] Read before the Annual Meeting of the Western Surgical Association, Minneapolis, Minnesota, December, 1922.

"It was formerly taught that the pancreas developed in the vertebrates from two duodenal buds, or pouches, one dorsal, and one ventral, but it has now been shown, for most members of the group, including man, that the ventral bud in its early stages is double, so that a triple origin of the primitive rudiment, or anlage, of the pancreas is now generally accepted." (7). Two of these buds take part in the formation of the two permanent pancreatic ducts, namely, the ducts of Santorini, and Wirsung, the third undergoing atrophy. It is conceivable that should this atrophy not occur, as has been observed in other vestigal structures, that a permanent pouch or diverticulum may remain. Frequently masses of pancreatic tissue are attached to intestinal diverticula, and this has been observed by Opie (8) even in a diverticulum occurring in the ileum, and Falconer (9) reports a case occurring in the stomach with pancreatic tissue at its fundus. They have, therefore, been looked upon as a representation of an accessory pancreas.

An interesting point also in this connection, is the study of the comparative anatomy in some of the lower vertebrates, in which the pancreas is represented by numerous digestive cæca. In the salmon, for example, there are a hundred or more of these cæca, or pouches, disposed in a line along the whole length of the duodenum (Fig. 1).

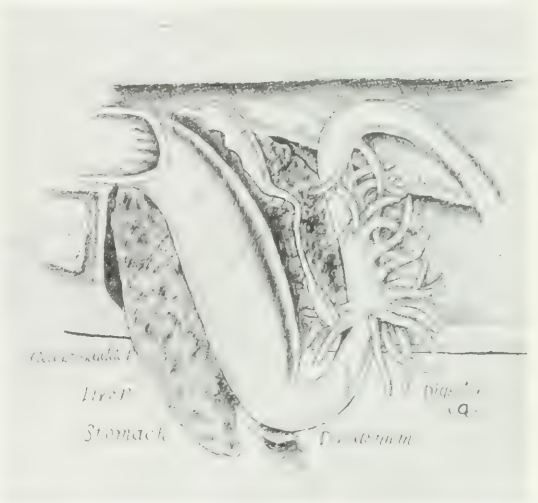

Fig. 1. Digestive cæca of the duodenum in the salmon. (Adapted from Parker and Haswell's *Textbook of Zoology*.)

ANATOMY

True and false diverticula have been described, this terminology indicating that, in the former, all the coats of the intestine are represented, in the latter the mucous, submucous, and occasionally the serous coat take part in the formation of the sac. They are usually situated on that aspect of the duodenum which is in contact with the pancreas, and frequently in the neighborhood of the ampulla of Vater, the "diverticula duodeni perivateriens" of French writers. Kath explains their frequency near the head of the pancreas as being due to the musculature of the duodenum being weakened by the ducts and large vessels penetrating its wall.

In discussing the surgical anatomy of duodenal diverticula, three points require emphasis: (1) the relation of the peritoneum; (2) the vascular arrangement; (3) the relation of the diverticulum to the pancreatic ducts.

Diverticula which arise from the anterior surface and greater curvature of the duodenum are covered by peritoneum, and are easily accessible. Those arising from the lesser curvature and posterior surface are, of course, devoid of peritoneum, and are difficult of approach.

The vascular arrangement in cases of diverticula arising from the concave border of the duodenum is important. The duodenal branches of the pancreaticoduodenal artery, and their accompanying veins, in some cases at least, arch themselves over the fundus of the diverticulum, and, as would be expected, are of a larger caliber (Fig. 2). This anatomical arrangement shows the importance of employing blunt dissection only, while freeing the sac from the surrounding structures. Furthermore, in the case of a concealed diverticulum, excision should be done only after the sac has been inverted into the duodenum and its base ligated.

The relation of the diverticulum to the pancreatic ducts demands consideration. As the pancreatic ducts lie near the posterior surface of the gland, a diverticulum, which is embedded in the head of the pancreas, will almost invariably lie anterior to the ducts.

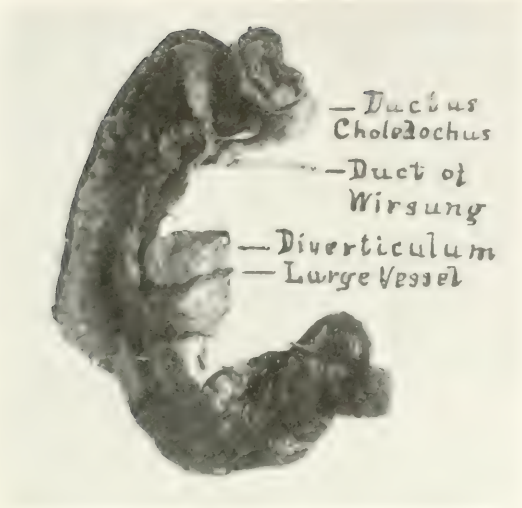

Fig. 2. Duodenum with diverticulum in the third part. Anatomical specimen in the museum of the Medical Department of the University of Manitoba. (Note the large vessel coursing over its anterior surface to the fundus. There is a similar vessel on the posterior surface.)

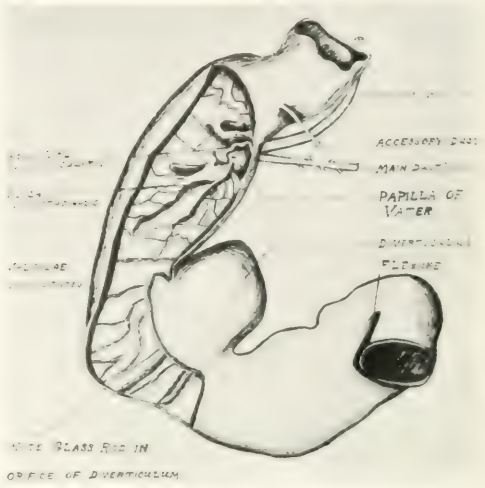

Fig. 3. Diagram of specimen shown in Figure 2.

This relationship can be further ascertained, after opening the duodenum, should this be considered necessary. The papilla of Vater is found by following the plica longitudinalis upwards, as this is the only longitudinal fold in the duodenum, the valvulæ conniventes being arranged transversely to the long axis of the bowel (Fig. 3).

ETIOLOGY

Two theories have been invoked to explain the occurrence of this condition: first, the distention or acquired, and second, the congenital theory. The points advanced in favor of the former or acquired are: (1) that they appear or produce symptoms late in life; (2) that they have been produced experimentally by distending the bowel with water (Hansemann, 1896); (3) that they occur on the mesenteric side of the bowel where the vessels penetrate the muscular coat (a locus minoris resistentiæ); (4) that in the sigmoid they have been found associated with and proximal to stricture due to carcinoma. As malignant change is common in intestinal diverticula, it is quite possible that the carcinoma developed in a pre-existing saccule.

Perry and Shaw (10) in 1893 classified diverticula of the duodenum as (1) distention, and (2) traction pouches. Increase in intraduodenal pressure results from closure of the pylorus above, and compression of the duodenum by the root of the mesentery below. This would appear to be a contributory cause, rather than a primary one, and could only produce a diverticulum where a congenital defect in the wall exists, as they rarely occur in association with the condition of megaduodenum. Traction diverticula are less usual, and are generally due to adhesions, the result of ulcer, or cholecystitis. This would appear to cause the condition that has been described as "tenting of the duodenum," rather than actual pouch formation.

Moynihan (11) and others have drawn attention to the fact that duodenal ulcer and diverticula are often associated, and a specimen, No. 1152, of such a condition is in the museum of the London Hospital. In a case recorded by Walter M. Jones (12), an ulcer was found opposite the diverticulum. He could find only three or four such cases in the literature. Ritchie's case (13) was also of this type.

The congenital theory is supported by the following facts: (1) diverticula have been found in infants at birth; (2) they are usually

single; (3) they have been found associated with diverticula of other organs, such as the bladder; (4) they have been found in other parts of the intestine, with pancreatic tissue at their apices; (5) their location near the ampulla of Vater, where the pancreatic ducts are developed from duodenal buds; (6) one case, at least, is recorded where the mucosa at the apex was thrown into folds, suggesting that it had not been subjected to full distention. Intra-intestinal pressure could not, therefore, have been the cause in this instance.

PATHOLOGY

The primary pathological changes that take place in a diverticulum of the duodenum do not differ from those occurring in the mucosa of any other part of the alimentary tract. They may be enumerated as catarrhal, ulcerative, suppurative, perforative, and malignant. These pathological changes are brought about by the retention of food particles within the pouch, which undergo stagnation, and decomposition. Other foreign substances may collect within the sac, as, in one case, 22 gall stones were found. This cess-pool of infection is responsible for all the pathological changes that take place within the sac wall, and furthermore may cause secondary changes in contiguous structures. These secondary changes may occur without gross ulceration or perforation of the diverticulum. They are due to the gradual migration of bacteria and toxins through the sac wall. This produces a hyperplastic condition in the tissues affected, as is so often seen in diverticulitis of the colon. Attention has been drawn to this by other writers, and in the author's case this fact was particularly exemplified, the sac wall being thin and soft, while the surrounding pancreas was markedly enlarged, and very indurated. Suppurative diverticulitis in this region probably does occur, but I have not been able to find a recorded case. Cases, however, are reported of suppurative diverticulitis of the colon, some with metastatic abscesses, as in the case reported by Foggie (14).

It is interesting to note that the age incidence of duodenal diverticulitis and of chronic pancreatitis are similar. In 30 cases of chronic pancreatitis, studied by Opie (15), 23 were between the ages of 40 and 70. It is at this period that the manifestations of duodenal diverticulitis have been most observed. In the writer's case the diverticulum was undoubtedly the cause of a diffuse chronic inflammation of the pancreas.

INCIDENCE OF CANCER

By analogy with diverticula occurring in the colon, one would expect to find carcinoma developing in these pouches connected with the small intestine. I have not been able to find a recorded case. W. J. Mayo (16) found carcinoma associated with diverticula of the large bowel in 31 per cent of his cases, and McGrath (17) in 25.9 per cent.

A possibility suggested itself that carcinoma occurring at the head of the pancreas might have had its origin in a pouch, and that in the examination this might have been missed. The relative frequency with which cancer develops in the head of the pancreas, as compared with other parts of this organ, suggests an extrinsic cause. Ewing (18), in 386 cases collected from the literature, found 158 diffuse, 156 limited to the head, 28 in the body, and 12 in the tail. Olliver has pointed out the necessity of very careful histological study in cancer of the pancreas, in order to avoid confusion with cancer of the duodenum and bile ducts. In the description of these tumors given by Kaufmann (19), and by Ewing, the cellular structure is pancreatic, and not that of duodenal mucosa. Ashoff (20) mentions, however, that many of the cancers of the pancreas are mucoid in character, and this would suggest an intestinal mucosal origin. Heinrich points out that "the occurrence of aberrant pancreatic tissue in the duodenal mucosa and about the head of the pancreas suggests that certain tumors, especially those involving both duodenal wall and pancreas, may arise from such aberrant tissue."

Duodenal pouches occur with a very striking relative ratio to that of primary cancer of the duodenum. Cole and Roberts (21), in a series of 30 cases, found their locations to be as follows: 23 were located in second part, 2 were located in first part, 2 were located in third part, 2 were located in fourth part, 2 were doubtful—first or second.

Jackson (22), in an anatomical study of 18 cases, found the pouches sixteen times in the first and second parts, and only twice in the third part. The incidence of cancer of the duodenum, as given by Rolleston, is, first part 8, second part 24, and third part 3, and by Geiser in practically the same ratio, 11, 51, 9 (Ewing, *Neoplastic Disease*).

Furthermore, it is generally conceded by pathologists that carcinoma is more prone to develop in an organ such as the liver or pancreas, which has become cirrhotic. As cirrhosis is the result of chronic irritation, it is conceivable that, in some cases of cancer at the head of the pancreas, an overlooked diverticulum may have been the exciting factor.

SYMPTOMATOLOGY AND DIAGNOSIS

There are no pathognomonic symptoms of this condition, and a diagnosis can not be made on clinical evidence alone. A diverticulum of the duodenum may be present without producing any noticeable ill effects. When causing symptoms, however, they must be due either to distention or inflammation of the sac, or its surrounding structures. As the site of the diverticulum varies, so will the symptoms vary to some extent; that is, symptoms due to complications rather than the original lesion. By far the greater majority of these pouches occur in the descending portion of the duodenum, and are paravaterian in type; therefore, the symptoms of an associated chronic pancreatitis, as in the writer's case, will at times becloud the clinical picture. The following symptoms are obtained from an analysis of the cases recorded in the literature. *Pain* is a most constant symptom. It varies from a dull ache to a sharp, lancinating or colic-like pain, suggesting gall stones. The pain is usually referred to the epigastrium, and in some cases through to the back, and to the right scapula, but on pressure the maximum point of tenderness is usually found above the umbilicus, and to the right of the mid-line. The discomfort or pain commences from 2 to 4 hours after food. The regularity with which this occurs is the most valuable point in distinguishing this from a primary chronic pancreatitis or cholecystitis, which is not influenced by the intake of food. The question of duodenal ulcer at once arises. In this connection the history is of the greatest importance. These cases of diverticulitis do not present the true history and symptomatology of ulcer, either gastric or duodenal (Smithies, 23). Furthermore, the pain is not relieved by eating. The close mimicry to symptoms of biliary colic is readily understood, when remembering that the majority of these diverticula develop in such close proximity to and from the same duodenal segment as the biliary tract.

Vomiting occurred in some of these cases, and jaundice was rare. An elevation of temperature has been recorded. Constipation appears to be a most constant complaint. These symptoms are common to various upper abdominal diseases, and do not of themselves constitute a characteristic symptom-complex. Likewise the symptoms of this disease manifest themselves at the age when diseases of the bile ducts and pancreas are common, and the symptoms referable to each condition cannot always be differentiated.

I believe, however, that in a patient late in life, presenting indefinite and atypical symptoms of an upper abdominal condition, in whom a duodenal diverticulum is demonstrated by the X-ray, especially where retention of barium is marked and tenderness is elicited on pressure directed over the pouch, duodenal diverticulitis can confidently be diagnosed and surgical treatment advised.

The technique employed in the X-ray demonstration of these diverticula has been dealt with by J. T. Case, in the article already mentioned. He states, however, that "having discovered a diverticulum, one should note (a) the exact location; (b) its size and general shape; (c) the dimensions of its orifice, whether narrow or free; (d) its mobility under the examining finger, guided by the fluoroscope; (e) the degree of retention; (f) relation of the shadow to a point of abdominal pain on pressure; (g) caliber of the duodenum proximal and distal to the diverticulum; (h) emptying time of the stomach."

SURGICAL TREATMENT

A diverticulum causing definite symptoms is undoubtedly surgical. The frequency with

Fig. 4. The operation of transduodenal diverticulectomy. The index finger of the left hand is passed through the incision in the duodenum and then into the diverticulum as a guide. The diverticulum is freed by blunt dissection, inverted into the lumen of the duodenum, ligated, and removed.

which this condition is missed at exploratory operation emphasizes the importance of a pre-operative diagnosis. Even when a diverticulum has been demonstrated by X-ray prior to operation, cases are recorded in which it has not been found. As the most frequent situation is on the concave side toward the pancreas, and buried within its substance, this difficulty can readily be understood. These points serve to emphasize the importance of exact pre-operative localization so far as this is possible. The operations that have been performed for the relief of this condition are excision, invagination, and in one case, posterior gastro-enterostomy (Cullen, 24).

In discussing the operative treatment, diverticula of the duodenum may be divided into two types: (1) those that are on the part of the duodenum covered by peritoneum, and are obvious when the abdomen is opened; and (2) those that are concealed within head of pancreas or lie behind it or duodenum.

In the former the technique will vary somewhat according to whether the diverticulum is pedunculated or sessile. The choice lies between invagination or excision. In either case besides two rows of sutures in intestinal wall, an omental graft should be applied.

In the concealed type I have found no recorded case where the diverticulum has been removed. The technique which I adopted in the case under consideration occurred to me after opening the duodenum for the purpose of exploring the common bile duct, as in the operation of transduodenal choledochotomy, palpation being difficult because of the thickened pancreas. Considering the history of gall stones removed and the symptoms complained of, exclusion of stone in the common duct seemed essential. During this exploration I was able to introduce my index finger into the diverticulum and by using it as a guide, cut through the overlying pancreatic tissue down to the sac, and by blunt dissection separate it from the indurated pancreas. It was then inverted into the lumen of the duodenum and ligated. The incision in the duodenal wall was closed

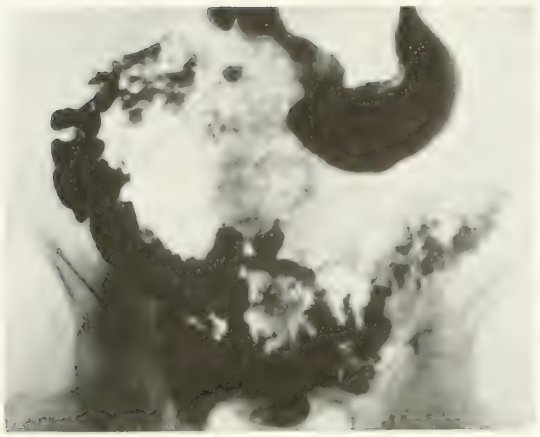

Fig. 5. Roentgenogram 5 hours after the ingestion of opaque meal, showing barium in the diverticulum.

Fig. 6. Roentgenogram 48 hours after the ingestion of opaque meal, showing barium still in the diverticulum.

and covered with an omental graft. A drainage tube was inserted down to the incision in the pancreas. This operation I have called transduodenal diverticulectomy (Fig. 4).

RECORD OF CASE

Mrs. O., age 58, January 3 1922, referred by Dr. E. W. Montgomery, with diagnosis of diverticulitis of the duodenum. The patient complained of stomach trouble, associated with recurrent attacks of epigastric pain, gas, and vomiting. The family history was negative to malignancy and tuberculosis. Patient was the mother of six children. Two children died of bronchitis in infancy. Following the first confinement sepsis occurred but with a good recovery. Menopause 3 years ago. Patient had summer diarrhœa for several years between the ages of 25 and 30. Cholecystectomy was done in March, 1918, for symptoms identical with those complained of at present (38 gall stones found).

Present illness. Following cholecystectomy, in March, 1918, she continued to have attacks of pain. For a time these attacks seemed less severe and less frequent than prior to the operation. During July and August of this year, she felt perfectly well. Since then, however, her trouble has returned with increasing frequency and severity. After eating, gas forms, accompanied by a distressing pain below the ensiform process. This pain is referred through to the back, and up to the right scapula. Belching of gas or vomiting affords her some relief. Symptoms commence about one hour after food. Solid foods of any kind, even bread and butter, disagree with her. Fluids agree better. Morphine has been required to control pain. Patient sleeps well between attacks. There are no urinary symptoms.

Examination. Heart and lungs negative. Blood pressure 130-70. There is in upper right abdomen a para-median scar, following cholecystectomy. The abdomen is negative to palpation, between attacks. During the attacks the upper abdomen is tender, particularly on the right side. There is also some spasm of the right rectus. No dullness. No mass can be felt. Pelvis and rectal examination negative.

Urinalysis: color, cloudy; reaction, acid; specific gravity, 1030; albumin and sugar, 0; microscopic, negative.

Gastric analysis: free hydrochloric acid, .05; total acidity, .20; no blood.

Blood examination: red cells, 4,970,000; hæmoglobin, 80 per cent; color index, .8; no anisocytosis; leucocyte count, 14,400. Wassermann test, negative.

Duodenal drainage was attempted twice. A Rehfuss tube was passed into the duodenum and following instillation of magnesium sulphate solution patient became distressed and complained of severe pain in epigastrium, necessitating withdrawing tube.

X-ray examination, December 28, 1921, barium series, by Dr. J. C. MacMillan (Figs. 5 and 6). Stomach is atonic and low. The pars pylorica is narrowed, in my opinion due either to external gastric pressure or adhesions, not to new-growth. The duodenal cap is normal. There is a diverticulum of the second part of the duodenum, which retains the opaque mixture for 48 hours. There is a marked gastric retention. The colon is negative.

Operation, January 9, 1922. Upper right rectus incision was made and the old scar excised. The great omentum was found adherent to the old incision, and the upper right abdomen was one mass of adhesions. The pancreas was very thickened, hard and nodular, from the head to near its tail. No fat necrosis was seen. A specimen of pancreatic tissue was removed, and swab taken from its cut surface. On account of the thickened pancreas, it was impossible to palpate the common duct, except at its upper part. The duodenum was then opened further to explore the common duct, which proved negative. The index finger was then in-

serted into the diverticulum and using this as a guide the sac was dissected out of the head of the pancreas, and invaginated into the lumen of the duodenum and ligated. The duodenum was closed, and a drainage tube inserted down to the incision in the pancreas.

Pathological report. The piece of tissue is disintegrated to such a degree that all trace of pancreatic structure has disappeared. A few collections of round cells can be recognized, suggesting the action of some chronic irritant. Beyond this it is impossible to go. *Swab.* Bacillus coli and staphylococci found. (Dr. Boyd, Pathologist.)

Patient's report. Writing December 3, 1922, patient reports: "At present I weigh 129 pounds (a gain of 26 pounds). I am feeling well and strong, and there are no indications of the former attacks."

CONCLUSIONS

1. Operations for cholelithiasis and diseases of the biliary tract are sometimes followed by unsatisfactory results. When stones are found in the gall bladder, the operator often feels satisfied and does not further explore the ducts, especially in the lower part. As I have had one case in which a stone was missed in the cystic duct, and two cases in which stones were missed in the common duct, and further as only one diverticulum in ten causes symptoms, the exclusion of stone in this case seemed most essential.

2. J. T. Case mentions that with a chronic pancreatitis, there is rapid emptying of the stomach. In this case there was a large 5-hour gastric retention. This might be explained from the low position and atonic condition of the stomach.

3. One of the striking features of the case was to find the diverticular mucosa soft and velvety and not very adherent to the surrounding pancreas.

4. The presence of micro-organisms outside the sac wall was interesting, illustrating that bacteria can traverse an apparently healthy intestinal mucosa. This has been found in other conditions, as bacteria have been discovered in the mesenteric glands without gross change in mucosa of bowel.

5. In discussing the symptoms of this case, the following questions arise: (1) were they due to distention of the sac from food becoming lodged therein; (2) were they caused by pressure on the pancreatic ducts from the distended sac; (3) were they due to a low-grade non-suppurative infection of the pancreatic tissue? The last would seem to be the more probable, as distention would occur regularly after every meal, and if the symptoms were due to pressure on the pancreatic ducts, one would expect to find some evidence of fat necrosis.

6. This case furthermore demonstrates the importance of a pre-operative diagnosis and localization of the diverticulum, and shows how readily this condition can be missed at an exploratory operation.

7. A duodenal diverticulum having been demonstrated by the X-ray, it would be for the clinician to decide whether it was a case of diverticulosis or diverticulitis. Furthermore, the surgeon in operating, if he finds an associated pathology more likely to be causing the symptoms than the diverticulum, would be wise to deal with that primarily, and await results. In this case the surgeon who removed the gall bladder, containing gall stones, even had the diverticulum been demonstrated at that time, did the wisest thing for the patient.

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POSTOPERATIVE VENTRAL HERNIA[1]

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THE development of hernia in the incision following abdominal operation is such a common and distressing complication that I feel justified in discussing it and adding one more paper to the already voluminous literature on the subject. As Judd says, it is often true that the development of postoperative hernia is a secondary consideration and is often unavoidable following severe and extensive abdominal operations; yet many times this condition can be prevented by the proper choice and manner of closing the primary incision. Recurrences following attempted repairs of such hernias are also so very common that I feel sufficient care is not taken in the pre-operative treatment, in the selection of the suture material to be used, in the type of closure advisable in any given case, and in the postoperative treatment.

It is hard to determine with any degree of accuracy the incidence of postoperative hernia, as a large majority of the patients probably never come to the surgeon for relief, but are content to put up with the inconvenience of an abdominal binder or some style of truss rather than face another operation. This is particularly true of the uniform bulging of the whole length of the incision due to a weak scar which, as a rule, is attended with very little or no pain, and which after attaining a certain size remains stationary. The patients who seek surgical relief are, as a rule, having sufficient symptoms to interfere with their regular work, either as a result of pain (which in many cases is constant, but in others is in the form of acute attacks as the result of partial, or more rarely, complete obstruction) or from the size and inconvenience of the large protruding mass.

From January 1, 1915, to December 31, 1919, 28,970 abdominal operations were performed at the Mayo Clinic, and of these 596 (2.05 per cent) were for the repair of postoperative hernia. Besides these there were several operations for recurrent umbilical and recurrent direct inguinal hernias which should also be correctly classified as postoperative hernia, but will not be included here.

In a series of 155 operations for various forms of hernias, Deaver and Ross reported 7 postoperative hernias. Dodge, in 1919, reported only 11 postoperative ventral hernias in 638 operations for hernia, but his patients were all young adult males and not of the type in whom we expect abdominal operations to be followed by incisional hernias. Coley, in 1917, published statistics from the Ruptured and Crippled Hospital, and reviewed 5,617 operations for various forms of hernias. He reports only 94 ventral hernias, but his data are somewhat misleading as to the true incidence of the condition since the majority of his patients were children.

During the 5 years in which the 596 patients were operated on for incisional hernias at the Mayo Clinic, we also operated on 4,249 inguinal hernias, 217 femoral, 327 umbilical, and 113 miscellaneous hernias. The postoperative hernia, therefore, constitutes 14.66 per cent of the total number of operations for hernia. In this series 84 cases were recurrent. In 134 the original operation had been done at the Clinic and in 462 it had been done elsewhere.

Postoperative ventral hernias develop in the majority of cases as the result of sepsis. This is unavoidable in many cases since drainage is instituted at the time of the primary operation, and a wound that has any form of drainage protruding from it for several days can not be kept free from infection. The next most common cause is probably increased intra-abdominal pressure as the result of paralytic ileus, vomiting, cough, hiccough, sneezing, straining during lavage, or as the result of urinary retention, or while at stool. In other cases extreme restlessness, with frequent changing of position and the necessary use of the abdominal muscles, tends to

[1] Read before the Western Surgical Association, Minneapolis, Minnesota, December, 1922.

cause cutting of sutures, hæmorrhage between the co-aptated surfaces and an excessive amount of œdema in the edges of the wound which interferes materially with solid union. Another potent cause is improper closure. This may be the result of an attempt to save time following a severe operation, or more often an attempt to save time for the surgeon. In some cases the upright posture is resumed, or too violent exercise commenced before the scar is strong enough to stand the increased strain. A rare cause is poor healing in debilitated, starved patients in whom there is little or no attempt at union in the ordinary length of time required. All these predisposing causes to weaken wounds are increased when the patient is overweight.

The symptoms naturally vary greatly depending on the nature of the hernial content, whether or not it is adherent, incarcerated or strangulated, whether it is in the upper or lower abdomen, the type of work the patient is doing, and last, but not least, his psychological attitude. It is not uncommon to meet patients who consider themselves invalids because they have small ruptures or weak bulging wounds that are not giving definite physical symptoms and that are not likely to become strangulated. Other patients will continue to do heavy manual labor, with little or no complaint, in spite of large irreducible postoperative hernias.

TREATMENT

Treatment will naturally be divided into preventive treatment, which will include the preparation of patients for any abdominal operation, the closure of abdominal wounds, the type of anæsthesia to be used, and the postoperative care. Under curative treatment will be considered the various types of operative closure for incisional hernias, suture material, postoperative care, and, if operation is not performed, mechanical support.

Patients most likely to develop postoperative hernia are obese, and have pendulous, flabby, abdominal walls. This condition is most often met with in healthy women who have had frequent pregnancies and are above normal weight, and in men who overeat and drink and do not take sufficient exercise.

Fig. 1. Plastic overlapping closure in cases in which anatomical closure is not possible.

Pre-operative medical management of such patients is of the utmost importance. They should be put to bed on a restricted diet with increased elimination in order to reduce weight and to lower blood pressure. Not only will postoperative hernias be less common following such care, but the operative mortality will be greatly reduced. Local nerve blocking is the anæsthesia of choice, and if necessary, supplemented by nitrous oxide or ether to aid relaxation.

TECHNIQUE

Nature is very kind to the surgeon and no matter what technique is used in the closure of a wound, provided there is fair apposition of the cut surfaces, the result will be a solid wound in most cases, if there are no complications such as infection or other postoperative condition that will tend to increase the strain on the opposed surface, or a constitutional state that will interfere with healing.

The manner of closing wounds naturally depends on the tissues concerned. These, of course, vary in different parts of the abdominal wall and a closure that would be satisfactory in one place would not be satisfactory in another. Before discussing the various types of closure I shall consider the relative frequency of postoperative hernias, as observed in the Mayo Clinic. Of a total of 592 cases, 84 were recurrent, 189 occurred in the

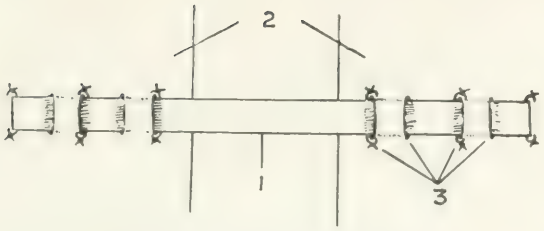

Fig. 2. Diagram showing method of fixation of "strip" transplant by weaving through slits in the fascia on either side of the gap. *1*, "Strip" transplant; *2*, edges of gap in fascia; *3*, slits through which strip is woven and fixed by sutures (Gallie and LeMesurier).

straight incisions in the rectus muscle, 173 in the low middle line incisions, 123 in the split muscle or McBurney incisions, 15 in high middle line incisions, and the remaining 12 in the rarer forms of incisions. These data are not of much value since I do not know the relative frequency with which these incisions were used; this varies naturally with different operators. Many of the 512 patients of whom we have fairly complete records were operated on originally for acute abdominal conditions, and in 280 (54.68 per cent) some form of drainage was used. I shall emphasize only a few important points in closure of wounds:

1. Approximation must be accurate, or better, the peritoneum may be overlapped or duplicated, special care being taken that no tags of omentum escape between the stitches.

2. Hæmorrhage must be controlled as thoroughly as possible.

3. Muscle tissue should be approximated without undue tension.

4. Fascia should be overlapped wherever possible.

5. All buried suture material should be of catgut or some absorbable suture material.

6. Tension suture should be inserted to guard against excessive strain on the approximating sutures when plain catgut is used. Silkworm gut is very satisfactory and in my opinion a through-and-through suture is preferable.

I should like to direct attention to the fact that in the series of 512 cases, 173 (33.78 per cent) occurred in low middle line incisions, and in my experience this is about the only location in which postoperative hernias, which were not preceded by infection, occur. It is

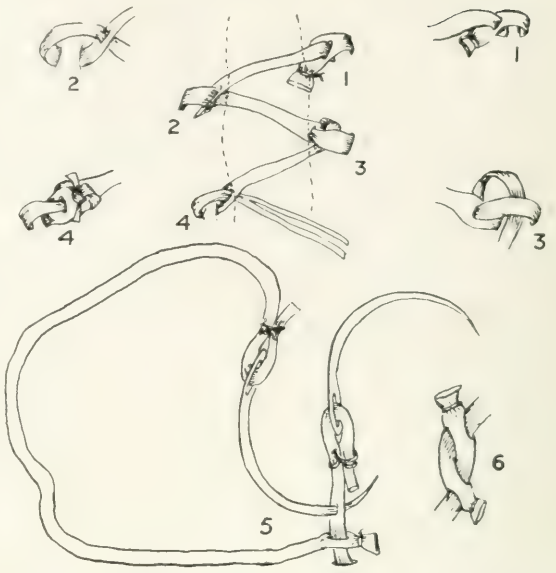

Fig. 3. Diagram showing method of inserting fascial suture. *1*, Anchoring suture at commencement by looping it through itself; *2*, fixation of suture at each loop by passing it through itself; *3*, fixation by passing suture through itself and tying in knot; *4*, ending of suture by passing through itself, splitting, and tying ends in knot; *5*, method of joining new suture to one that has been inserted; *6*, joint completed (Gallie and LeMesurier).

true that a weak scar with considerable bulging often follows extensive incisions in the upper part of the rectus muscle without infection, as the result of atrophy of the inner fibers of the muscle following cutting of several branches of the motor nerves, but these cases seldom come to secondary operation, whereas a weak scar in the low middle line generally gives trouble. To guard against future trouble in a low middle line incision, it is advisable to open the sheath of the rectus on each side and make a closure exactly the same as in the ordinary straight incision. In women who have had repeated pregnancies there is often a weak point just below the umbilicus as the result of marked diastasis of the recti muscles. In these cases it is advisable to excise the umbilicus and overlap the aponeurosis for a short distance.

PRE-OPERATIVE TREATMENT OF POSTOPERATIVE HERNIA

The size of a hernia is no guide to the amount of trouble it may give, as a small

opening through which a single knuckle of bowel or tag of omentum may become incarcerated, or strangulated, is often much more dangerous than a large opening through which a large quantity of abdominal contents protrudes and may even be adherent or irreducible. No preliminary treatment is necessary for the small hernias, and their closure will be exactly the same as that employed for the larger ones.

Massive hernias, particularly in obese patients, require special pre-operative treatment, not only to make the surgical risk less, by reducing the weight of the patient, lowering the blood pressure, and aiding elimination, but to reduce the herniated mass as much as possible. The sudden reduction at the time of operation would greatly increase the intra-abdominal pressure; this in itself adds to the danger of recurrence, and in many cases is the cause of marked cardiac and pulmonary embarrassment. Under dietetic management and rest in bed, either in a hospital or at the patient's home, from 20 to 30 pounds can be taken from the weight in from 3 to 6 weeks. During this time the hernial protrusion is returned and retained in the abdominal cavity as much as possible.

When deaths occur following operations for large postoperative or umbilical hernias, the most striking symptoms are of cardiac or pulmonary embarrassment, but there is always a diminished urinary output with definite symptoms of a metabolic upset. I am sure that investigations recently started in the Clinic of the blood chemistry of these cases will be of interest and possibly of some aid in determining when it is safe to operate.

The type of operation best suited to any given case depends on the conditions found. If an anatomic closure can be effected without undue tension, it is the method of choice, but in the great majority of cases this is not possible on account of marked loss of the muscle tissue as the result of infection or injury to the nerve supply. In these cases a plastic overlapping, on the same principle as the Mayo operation for umbilical hernias, is advisable. It is extremely important to remove all possible fat from the surfaces that are to be brought into apposition, and to

Fig. 4. Fascial suture at end of 13 weeks, showing method of insertion. The suture is now a rounded, glistening cord, resembling tendon in gross appearance (Gallie and LeMesurier).

obliterate any space in which serum or blood might accumulate. Wherever possible, the overlapping should be vertical rather than from side to side in order to avoid the pull of the lateral abdominal muscles (Fig. 1).

A mistake often made is an attempt to overlap too much. Undue tension is a common cause of failure and overlapping of 2 centimeters is often preferable to one of 5 centimeters. Twenty-day chromic catgut No. 1 or No. 2 is the suture material of choice. If satisfactory union is not well started in 3 weeks, it will never be obtained. Permanent suture material will simply act as a foreign body and will often lead to trouble. Any tension greater than No. 2 catgut will stand will cut the tissue, and œdema, which will interfere with healing and predispose to recurrence, will result. Tension sutures of chromic gut are best applied after the insertion of one row of a continuous mattress suture which closes the peritoneal cavity; if desired, the knots can be tied between the flaps. Accurate approximation is then made by placing the overlapping flap on top of the lower flap. Either continuous or interrupted sutures may be used. In many cases such closure is far from perfect, as it is simply an overlapping of scar tissue with little or no

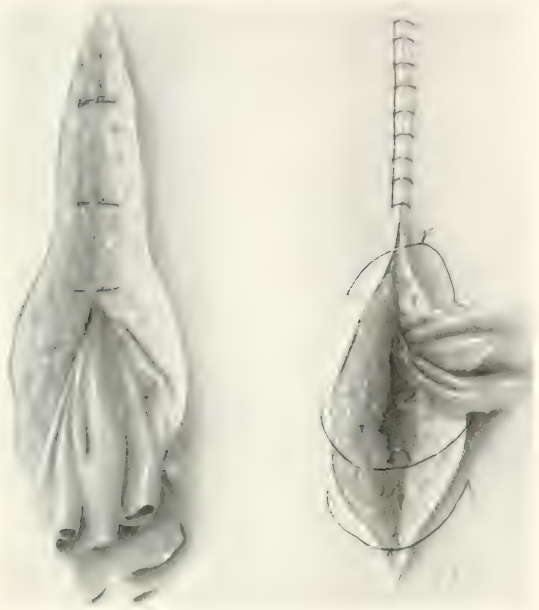

Fig. 5. Method of using rubber tissue drain following operation for massive hernia. Secondary closure.

muscle, and for these Gallie and LeMesurier have advocated the use of "living sutures" made of narrow strips of fascia lata from the patient himself and closing the hernial opening in much the same way that a hole in a stocking is darned (Figs. 2, 3, and 4). This method is much better than a mass implant of fascia lata as advised by some writers. I have not adopted this technique in detail, as I believe a great deal can be gained by the simple overlapping of scar tissue and I never sacrifice it. However, in several recent cases I have reinforced the regular plastic overlapping closure with several living sutures taken from the fascia lata and am satisfied that it adds materially to the strength of closure and is a real advance in the treatment of such cases. The three layer method, as advised by MacLean for the closure, of umbilical hernias associated with a marked diastasis of the recti muscles may also be useful in some of these cases.

Bevan advises whipping the edges of the hernial opening together without opening the peritoneal cavity. This might be satisfactory in small hernias, but I see no advantage or added safety in the method and in cases of adherent intestinal loops, obstruction might result from the altered position.

Gibson and others have advocated pedicle flaps of fascia to close the hernial opening. I have had little experience with it. I believe that the overlapping method, with the addition of a few reinforcing stitches of living sutures, will usually afford the best results.

After closing the deeper layers, the best method of closing the superficial layers is often a problem, particularly if it has been necessary to make a large incision and if the patient is very fat. The average weight of these patients in the Clinic was 163.8 pounds.

Tension sutures of silkworm gut afford added security if the abdominal walls are thin; the sutures may remain 15 or 18 days. In obese patients, however, with a layer of adipose tissue of 7.5 centimeters or 10 centimeters between the knot on the skin surface and the deeper layer that is being united, I do not believe this of any value, but rather a danger because of the possibility of cutting and infection.

Drainage with the ordinary tube has not been entirely satisfactory and attempting to close without drainage often results in the collection of a large amount of blood, serum, and broken-down fat which later, becoming infected, causes a great deal of trouble. To overcome this I have recently packed the wound with rubber tissue, and closed it about half way in the ordinary manner, leaving loose stitches in the other half of the wound to be tightened in 48 hours, after the removal of the rubber (Fig. 5). I have tried this in a few cases and found it very satisfactory. The advantages claimed for this partial secondary closure are: removal of a large quantity of blood and serum which would otherwise be retained in the wound and possibly cause late infection, removal of fat that would be absorbed and predispose to fat embolism, and the slight inconvenience to the patient since it can be done while he is in bed. If the patient is nervous a little nitrous oxide and oxygen may be used.

RESULTS

Results are very satisfactory; nevertheless recurrences are fairly common. In our series

of patients 84 had had at least one previous operation. Of the 596 patients operated on, 134 (22.48 per cent) have weak wounds with more or less bulging, but only 54 (5.7 per cent) are complaining of slight inconvenience, and only 20 (3.35 per cent) report no improvement. Ten of these patients had been operated on before coming to the Clinic, and I believe I am safe in saying that the oftener a hernia is operated on the harder it is to obtain a cure. Coley and Hoguet reported 11 recurrences in 103 cases.

MORTALITY

The mortality for postoperative hernias is high. This is due to the fact that a relatively large number of the patients are extremely poor risks. McGlannan estimates the mortality at 6 per cent in the massive hernias without strangulation, and as high as 50 per cent in the strangulated. In our series there were only 4 deaths (1.78 per cent), but in none of our cases did strangulation necessitating resection occur, and the majority of them would not be described as massive.

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LUNG COMPRESSION BY HEAVY LIQUID PARAFFIN IN THE TREATMENT OF LUNG TUBERCULOSIS, BRONCHIECTASIS, AND LUNG ABSCESS

By F. W. McGUIRE, M.D., F.A.C.S., Buffalo, New York
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ONE of the first principles in the treatment of all diseases, no matter what part is affected, is rest. In diseases of the lung, it is impossible to give rest unless some mechanical means is employed. When we consider the number of excursions the lung pursues in its daily performance of its duty (about 28,000), we can readily see the difficulties there are in treating its disease located here. When tuberculosis is found elsewhere in the body, every effort is made to immobilize the part.

Since the beginning of medicine, pneumothorax has been practiced to immobilize the lungs. Hippocrates (1) described its use in the fourth century, B.C. To A. K. Krause is due the credit of refreshing the literature on this point. James Carson (2) of Liverpool, England, in 1821 described some experiments on animals with it and thought it could be used in the human being. James Houghton (3) in 1832 reported cases which had improved, following spontaneous pneumothorax. Folani, of Pavia, Italy, reported in an Italian medical journal in the early nineties, the use of nitrogen in the treatment of chronic tuberculosis. The late J. B. Murphy (4) of Chicago, in 1898 put the treatment on a more practical basis. After Murphy, a number of men acting on his suggestion, reported very encouraging results. Later, Brauer (5) and others took up the work in Europe, and reported cases. During the past 15 years a number of men reported successes, among them being Sachs (6), B. Stivelman (7), and A. F. Miller (8), of Novia Scotia. The brilliant results accomplished as revealed in some of the reports make one wonder why other institutions have not used nitrogen. The reason may be the difficulties that attend its use in producing pneumothorax, for it is sometimes necessary to repeat the procedure at intervals of 10 days to 2 weeks, and effusion occurs in about 55 per cent of cases.

During the past year I have been carrying on experiments with rabbits and cats, with the hope of finding something that would not produce effusion nor be absorbed as readily as nitrogen. I have been using principally heavy liquid paraffin, but in a few instances I have used light paraffin. These experiments were carried out in the Physiology Research Laboratory of the University of Buffalo, during the summer of 1922. The animals used, 6 rabbits and 16 cats, were of different sizes, ages, and breeds, and were fed upon the same diet before and after operation —a full ordinary diet. They were allowed to run loose in a large, well ventilated, cement room opening into a high-walled run-way.

TECHNIQUE

Breakfast was omitted on the day of operation. The animal was anæsthetized—ether or nitrous oxide and oxygen being used. The anterior and lateral aspect of the right chest was shaved, and the skin sterilized. When 100 cubic centimeters of oil was injected into cats anæsthetized with ether, 3 died; when compression anæsthesia with nitrous-oxide and oxygen was used, we could inject 150 to 200 cubic centimeters without mortality. From this we may infer that, when inducing pneumothorax in individuals who suffer from pleural shock, compression anæsthesia with oxygen will prevent fatalities.

With the exception of the first two animals, the oil was injected through a 14-gauge needle connected to a 50 cubic centimeter Luer syringe, with an Adler valve attached for refilling. The puncture was made in the anterior axillary line in the sixth interspace.

Autopsies have been performed on all the animals. The following is a report made

November 16, 1922, by B. M. Roman, pathologist to the Buffalo General Hospital.

A complete atelectasis was not brought about even on the oldest experiments. On the other hand the lung in the cavity which contained oil was found to be generally somewhat smaller, and also there was total collapse of one or the other lobe. This condition was also occasionally found on the non-injected side which contained oil.

On the injected side, the lung always showed, in patches, a pneumonic process. The number of these patches increased as the time of contact of the oil with the lung lengthened, excepting in the experiment in which the oil had been injected into the chest cavity only 14 days. Besides this pneumonic process in the lung, the pleura and the soft parts of the mediastinum were diffusely thickened in the form of patches.

Absorption of the oil apparently did not take place within the circulation. What could not be recovered from the chest cavity in a free state could easily be accounted for by its accumulation in the tissues.

Fate of oil. 1. In some cases depending upon factors to be determined, the oil passed through the mediastinum to the opposite side, possibly by a process of suction, in which case it sometimes became coarsely emulsified.

2. In some instances it was transported through the lymph channels into the lymph glands.

3. In some cases it was transported by means of phagocytes.

4. In some instances the oil became tied up in the proliferating process of the cells of the pleura, soft tissues, etc., as they became thickened.

No effusion was found in any of the cases.

Chemical Report of Guy E. Youngburg, M.S.

		Specific gravity 20°	Amount of oil cubic centimeters
Original oil	..	.852	..
Oil from cat	10	.852	93
	13	.852	14
	14	.852	45
	15	.852	50
	16	.852	9

The oil from the cats contained a small portion in the form of a thin emulsion, which largely separates on standing. This seemed to be an admixture of the oils with small amounts of mucinous matter, doubtless the result of the mechanical movement of the oils in contact with the mucous surfaces of the organs.

The oils had, in all probability, not dissolved any substance. This was at first indicated by the fact that there was no change in the specific gravity as there would likely have been if any substance had been dissolved by the oil.

Chemical tests for fats, lecithin, and cholesterol showed none of these present. Chemical tests for very small amounts of nitrogenous substances were found to be more difficult to make than at first anticipated. But by the procedure used there could be found nothing more than traces of any nitrogen-containing substances.

From the chemical examination, it would seem that the use of paraffin in the pleural cavity had not caused any change.

Regarding administration, I am satisfied that injecting the pleural cavity to its full capacity is a wrong method. In treating tuberculous patients I am using 50 cubic centimeters for the initial dose, and in 2 weeks I am following this by 200 cubic centimeters. At the end of another 2 weeks another 200 cubic centimeters is added. If more is considered necessary, it is given in the same ratio.

By injecting the paraffin as described, I believe the pleural cavity becomes gradually accommodated to the introduction of the oil, and the mediastinum is better stabilized. Nitrogen, I believe, can be used with greater efficiency, if the preliminary dose of 50 cubic centimeters of oil is used in the pleural cavity 2 weeks previous to administering the nitrogen.

Regarding the loss of paraffin injected, we have been able to recover from 75 per cent to 90 per cent of the totals in animals, and we believe if used in the human being at rest, the loss will be further reduced. Undoubtedly the activity of the animals must account for some of the loss.

The pneumonia which was found by the pathologist occurred in scattered patches.

The animals did not have any temperature and were clinically well, so that this is irrevelant clinically, and rather to be desired since the object of introducing the oil is to put the lung out of function.

I wish to express my appreciation for the able aid given me by Hon. Thos. B. Lockwood, Doctors J. H. Evans, E. W. Koch, B. M. Roman, R. H. Waite, H. U. Williams, B. T. Simpson, and G. E. Youngburg.

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RARE MALFORMATION OF THE VULVA

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CATHERINE P., age 32, from Turin, Italy, a prostitute, came for treatment of an anal venereal ulcer. The history reveals nothing relative to genital or other malformation in the family. At the age of 8, while she was at the theater, she fell on a seat with her legs abducted. She remembers seeing some blood in the vulvar region. Her mother treated her and she was well after a few days. Physical examination shows the patient to be normal with lines of chest and abdomen regular and like those of a nullipara. The cervix of the uterus, the fornices, and remainder of the vaginal wall are normal, as are likewise the internal genitalia. There are no gonococci in the vaginal secretions. The Wassermann is negative, and menstruation is regular.

She does not remember having observed any change in the form of her genitalia. She makes no complaint whatever. Coitus is normal but she admits that there is a slight enlargement of the clitoris during the orgasm. She states that she is rather cold to the embraces of all her clients, and that she does not feel excessive enjoyment even with her own lover. She rarely practices masturbation. She claims to have had a woman friend before giving herself to prostitution, with whom she lived, but denies that their relations were any other than those of common friendship.

External genitalia. With the thighs slightly abducted, there is seen to extrude for about 0.5 centimeter from the anterior angle of the closed labia majora, a cutaneous formation lengthened anteroposteriorly, which ends on its posterior side. The growth resembles somewhat a preputial cowl. On gently opening the labia majora we find, on the flat vulvar region, the above described formation very marked, and extending downward for about 19 millimeters. The clitoris is normal as to form and

Fig. 1.

Fig. 2.

position. It is slightly larger than normal, being enlarged about 1½ times. Anteriorly it is surrounded by a triple cowl, the superficial covering of which is formed by a slightly elevated cutaneous reflexion which fuses into the second one. The third cowl covers directly the gland and beyond this it becomes fused with the second cowl. This second cowl is thicker and rugous and extends backward, as normally, to form the origin of the labia minora. As such for a distance of 22 millimeters on the right and 30 millimeters on the left, they still resemble the normal labia minora. Beyond this, they terminate with a sharp posterior border, as if cut with scissors directed irregularly from above downward and from in front backward forming an acute angle with the vulvar region corresponding to the vestibule. In the tract corresponding to the postero-inferior margin, a cutaneous portion of the same structure about 3 millimeters wide unites, or bridges, the two margins so as to form the collar of the cowl. On separating the vulva with two fingers the normal looking glans clitoridis comes into view. Back of it there is an opening with mucus-like walls and smegma giving the impression of a preputial meatus. On lifting the portion which unites the two labia, there is an indication of a urethral canal (resembling a feminine hypospadias).

Proceeding anteroposteriorly, there is seen a vestibular area which is very smooth and devoid of any traces of a urethral meatus. Farther back there is a vaginal opening which is narrow, regularly oblong, and surrounded by very small and multiple cutaneous elevations (pseudo-terminal portion of the labia minora). On forceful opening of the vaginal introitus, there are seen the hymenal caruncles of a normal nullipara. Corresponding to the anterior angle there is indistinctly seen, better by the aid of a catheter, hidden among the hymenal caruncles, the urethral meatus. There is no trace of cicatricial tissue which might correspond to the trauma above mentioned.

This anomaly must be considered as a case of apparently rudimentary pseudo-feminine hermaphroditism. It is far from resembling the more or less marked cases of pseudo-hermaphroditism reported in the literature.

Our case did not have a clitoris of the size found in the striæ more or less developed in the androgyne. Bergh speaks of a posterior labial commissure, of a transverse fold, but he always describes a cowl so well shaped as to constitute a real masculine prepuce. In my patient there is only a bridge, a bridle uniting the posterior borders, which is not visible unless it is lifted, and is very far from forming a preputial meatus. Pozzi says that ordinarily with more or less advanced atrophy of the genital canal and hypertrophy of the clitoris, goes *pari-passu* feminine hypospadias.

In my patient the urethral canal is displaced backward so that the meatus is in the vaginal opening. The feminine type of external genitalia in the male is due to an anomaly of development; in a female the masculine type of genitalia is due to an abnormal development as a result of excess. In our case we find a slight over-development of the clitoris due to excesses, without any appreciable enlargement during erection or without other masculine characteristics, and we find too a developmental defect (rarely to be observed) of the labia minora, which are only partially normal in shape, and terminate sharply as if removed by a surgeon and become united by a weak, long and thin cutaneous flap.

In the descriptions of the shape of the labia minora in books and in case reports of pseudo-hermaphroditism of the androgynoid and gynandroid, there is always a complete absence or only a slight development of variable extent, as well as a symmetry in the formation of the labial folds, paranympheal folds (Jayle), but the labia minora always continue backward, diminishing gradually and disappearing on the side of the vaginal orifice; or there is the formation of a cowl resembling a prepuce, but only very rarely is there the brusque interruption after a normal conformation for a few centimeters so as to present the shape of a rudimentary pseudo-hermaphroditism.

Because of this, our case must be considered interesting only from the morphological side, as an anomaly of the labia and vagina (of the lower portion) caused by incomplete development, and simulating a rudimentary feminine pseudo-hermaphroditism, associated with an abnormal urethral meatus.

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ENDOTHELIOMATA OF THE UTERUS

With Report of a Case

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THE term, endothelioma, was coined by Golgi,[1] in 1869, in describing psammoma of the dura mater, but many other pathologists have not deemed it a suitable designation. Kolaczek,[2] who made the first résumé of the subject in 1878, preferred the term angiosarcoma. Weichselbaum and Nelson,[3] the next year called it endothelial sarcoma and endothelial cancer respectively. Marchand,[4] at the same time held to the term endothelioma. Of more recent writers, Ewing,[5] classifies it among the sarcomata.

The writer thinks the original term, endothelioma, should be retained. The cells are clearly of endothelial origin. The peculiar relation which they hold with respect to the blood and lymph vessels, and the nature of growth extension at the free edge of the tumor, are sufficiently characteristic to warrant this classification.

The endotheliomata are widely distributed throughout the body, because of their origin in the vascular endothelial cells. For this reason, all tissues which contain blood or lymph vessels are potential sites of the growth.

In the female generative tract, the ovary is most frequently involved; the uterus much less frequently. In 1908, Kadegrobow,[6] reviewing the literature, unearthed 27 cases of endothelioma and perithelioma of this organ. He also found 59 cases of ovarian tumor, together with 2 cases involving the vulva and broad ligaments. These figures represent the relative frequency in the two organs. To date the author has been able to locate 48 cases, to which he is adding one more. Errors in diagnosis, lack of routine study of all pathological specimens, and lack of a settled classification, reduce the number of reportable cases very greatly.

The clinical manifestations of the disease are varied. None is pathognomonic. The chief signs are those of malignancy, which vary with the part of the organ attacked. Both the fundus and cervix are vulnerable, the latter much the more frequently. The disease is often engrafted upon a previously existing myoma, a phenomenon which has been observed by a number of writers. Whether, however, this relationship is anything but accidental, is still a question. The age of incidence is really, in all probability, the main reason for this connection between the two.

The specimens removed at the operating table present varied appearances, ordinary carcinoma and degeneration of pre-existing myomata predominating. Here again, nothing is pathognomonic. In a large number of cases the consistency is that of brain, and the specimen is pinkish-white in color, suggesting sarcoma. This resemblance is the most frequent, and the specimens simulate sarcoma more than any other condition.

The final diagnosis rests upon the microscope. Here, likewise, the picture varies. Large endothelial cells, spindle-shaped and elongated when at the periphery of the growth and more spherical when at the center, due to mutual pressure, predominate. Frequently they are grouped in nests and strands. A diagnostic feature is the peculiar relation which the cells bear to the blood and lymph vessels.

Under low power magnification, one sees a vessel with a very thick wall. This substantial support, in most of the sections observed, tends to prevent the lumen from collapsing. The wall consists of closely

packed endothelial cells. Growth is parallel to the lumen, and no teat-like projections extend into the surrounding tissue. Very little intercellular substance is in evidence. The lumen in most cases is not invaded. The cells themselves are large, with deeply stained and slightly elongated nuclei, which fill most of the cell body. Pigment granules within the cell body, seen occasionally, demonstrate the phagocytic powers of these cells, and help confirm the diagnosis of their endothelial nature. Occasionally giant cells are observed, and mitotic figures are quite frequently found.

The exact origin of the growth is still a moot point. The endothelium and the perithelium of the blood vessels and the endothelial cells lining the perivascular lymphatics have all been considered. Mallory and Strong[1] exclude the perithelium, believing it to be too indefinite a structure, and so far having been demonstrated only in the vessels of the dura, cord, and ear. Concerning the endothelial cells of the blood and lymphatic vessels, writers seem evenly divided. Definite proof is lacking which might decide the matter. In some sections blood corpuscles are seen in the lumina, while in other sections none is visible.

Even this is not definite proof that the source of origin is one type of vessel or the other. Lazarus-Barlow thinks that the presence of blood corpuscles suggests a blood-vessel source, while a circumscribed mass of albumin, which has coagulated in the process of fixation, with the formation of débris, points to a lymphatic origin. Ewing believes that the absence of blood corpuscles is evidence of a lymphatic origin, but its presence is of less significance, since abnormal channels form between channels of the tumor and the channels of the blood vessels.

In our own specimen, no corpuscles were observed in any of the sections examined, nor was any coagulated albumin found. The lumina seen were, however, thought to be blood vessels.

The endotheliomata are, by some, subdivided according to the nature of the growth. Extension into the lumina of the vessel is termed endothelioma, while perithelioma is the term applied when the lumen remains intact and the growth is in the peripheral direction. Both have been seen in the same case by some observers. The latter are called by Lazarus-Barlow, perientheliomata. In his opinion, the velocity of the blood stream militates against the ingrowing type, while the converse is true in the lymphatic system.

The endotheliomata are extremely malignant and of rapid growth. Kadegrobow found 11 cases of metastases in 27 of the uterine tumors. Lazarus-Barlow thinks that the metastases are more frequent in this type than in any other type of growth found in this region. After observation of 22 cases he found in 15, numerous and widespread metastases.

Treatment is, as yet, unsatisfactory. Ignorance of the cause of malignancy, and our inability to recognize cases sufficiently early make a bad prognosis. The fact that the diagnosis of endothelioma has never been made clinically, further adds to the difficulty. Complete surgical removal, and the actual cautery have been the only means of treatment employed in the cases occurring in the literature. At present, with short wave length therapy at our command, it would seem that the use of radium would be the method of choice, in selected cases. Surgery, however, will no doubt continue to hold an important place in the treatment of this condition, especially where the fundus is invaded. Radium, for involvement of the cervix, will no doubt become the method of choice there.

TABLE I.—INCIDENCE OF DISEASE ACCORDING TO DECADE

	Cases
From 10 to 20 years	2
From 20 to 30 years	1
From 30 to 40 years	12
From 40 to 50 years	9
From 50 to 60 years	11
From 60 to 70 years	6
From 70 to 80 years	1

ANALYSIS OF CASES

In Table II, 48 cases were reviewed. *Age.* In 42 cases, we find that the oldest was 70, the youngest 18. There was also one case

[1] Am. J. Obst., N. Y., 1914, lxix.

TABLE II—SUMMARY OF FORTY-EIGHT CASES FROM THE LITERATURE

Author	Age	Para	Metrorrhagia	Other Discharge	Pain	Systemic Disturbance	Previous Operations	Abdominal Tumor	Vaginal Examination	Pre-Operative Diagnosis	Treatment	Subsequent History
Amann	51	3	Last period 14 days	Yellow white, 5 wks.	3 mos. and $\frac{1}{2}$ backache				Tumor size of hazelnut on thickened posterior lip of cervix—not bleeding very much Gross: Firm, grey in color, ragged surface and fatty in appearance Microscopic: Large round cells fills most of cell body. Spindle shaped cells, lack of intercellular substance	Neoplasm of portio vaginalis of cervix	Panhysterectomy	Normal healing
Barnett	32	0				Weakness	1 year previously a cervical fibroid. Polypi removed; well for 3 years	Size 3 months' pregnancy; duration 2 years	Tumor to the touch, smooth surface Gross: Cyst—2 pints of dark fluid	Myoma with degenerative changes or pus or blood in the uterus	Supravaginal hysterectomy	
Sänger	31				Acute	Collapse		Size 8 months' pregnancy	Tumor elastic to touch	Hæmatometra	Supravaginal hysterectomy	Death on the 6th day—hepatic parenchyma
Bailliet and Watson	58	3	Yes	Watery; fœtid				Small rounded to the right side — size 3 months' pregnancy		Myoma and degeneration	Supravaginal hysterectomy	Well at end of one year
Beckham	43	2	6 mos.			Marked anæmia		Size 3 months' pregnancy			Hysterectomy	Metastases in new months—sheath in 18 months
Braetz	18	0	Yes 6 mos.						Papillary tumor 2 cm. high on posterior lip of cervix; bleeding and friable		Vaginal hysterectomy	Death in 3 weeks; met astases were suspected
Cova	38	2	Yes 6 mos.	Yellow		Slight anæmia			Fungoid tumor, size of a nut on anterior lip; spreading and friable; corpus normal size	Epithelioma of the cervix	Vaginal hysterectomy	Well at end of a year
Curtis and Vanwerts	39	4	18 mos.	18 mos. chocolate and odor	Yes			Hard mass above pubis	Tumor between bladder and uterus	Myoma and cancer of fundus	Hysterectomy	Death in 5 days; suppression of urine
Donald	25	0	6 wks.	6 wk.	Yes				Rounded swelling of the anterior lip of cervix; posterior stretched over it	Cervical fibroid	Abdominal hysterectomy	Recovery
Doran and Lockyer	40	5	6 yrs.			Emaciation and œdema of legs		Growing for 7 years	Uterus bulky and anteverted—size two fists	Large cystic tumor	Hysterectomy	Well at 4½ years

Same	36	2	6 mos.			Loss of flesh		Swelling on left side for 15 months; tumor above umbilicus; recent rapid growth	Cystic uterine fibroid rising above umbilicus	Malignant fibroid growth	Hysterectomy	Well 2 years and 7 months later
Duret	65		1 yr.		Severe lancinating to groin	Mental disturbance			Cervical polyp; friable uterus felt like a fibroma, retroflexed, size of adult fist	Fibroid and polyp	Hysterectomy	
Ewing	48		2 mos.	Foul; 2 months; pus					Uterus enlarged—tender os patulous—discharge of pus	Suppurating fibroid	Hysterectomy	Recovery
Gebhard	56	12	3 yrs.	Watery; 3 years	Cramps	Pressure on bladder			Tumor fist size in upper vagina; origin cervix	Fibroma uteri polyposum	Hysterectomy	Recovery
Gottschalk	51	1	Yes		Yes	Pressure on bladder ascites		Reaching navel; rapid growth in last 2 months		Myoma with suspected malignancy	Hysterectomy	
Graefe	30	1	Yes	Watery					Cauliflower tumor size of apple on cervix	Cauliflower tumor	Vaginal hysterectomy	Death in 8 months from metastases
Grape	54	3	1 yr.	Yellow; 1 yr.					Uterus enlarged; also tumor to left of the introitus		Hysterectomy	Death
Hansen	52	3				Polyuria; dysuria; frequency; urine negative		Abdomen enlarging for 2 years	None made	Sarcoma cysticum uteri	Supravaginal hysterectomy	Death few hours from hæmorrhage
Huizinga	63	0	1 yr.						Tumor size of a hazelnut on anterior lip of cervix		Hysterectomy	Well 1 year later
Hurdon			3 wks.		0 years; bladder region				Anterior lip of cervix destroyed; posterior lip thickened; uterine body small; ex os crater	Polyp	Hysterectomy	Death on 14th day; sepsis
Kirch-Gessener	34	3	18 mos.	Yellow and bloody; 18 mos.					Upper vagina a tumor the size of a walnut; uterus normal size	Polypoid tumor	Vaginal hysterectomy	Death 4th day; peritonitis
Kroemer	48		Yes						Hard friable tumor involving posterior lip of cervix; uterus enlarged		Hysterectomy	Death 6th day; peritonitis
Same	36	4	Yes			High grade cachexia			Uterus small; ulcerating tumor on the posterior lip of cervix	Ulcerating tumor on posterior lip of cervix	Vaginal hysterectomy	

TABLE II.—*Continued*

Author	Age	Para	Metrorrhagia	Other Discharge	Pain	Systemic Disturbance	Previous Operations	Abdominal Tumor	Vaginal Examination	Pre-Operative Diagnosis	Treatment	Subsequent History
Leith	42					Weakness, incontinence	Cyst 5 yrs. previously inoperable although attempted	Abdominal swelling since first operation		Large cystic growth	Hysterectomy	Well 6 years later
Marcuse										Endocervical epithelioma		
Same										Endocervical polypoid mass of suspicious nature		
Same										Inoperable and malignant pelvic tumor		
Maunsell	40	8				Weakness		Yes—with pus discharging from sinus below umbilicus; swelling 3 months	Left appendages and uterus normal	Sloughing myoma	Hysterectomy	Well 3 years later
McFarland										Sarcoma and a degenerating fibroid	Hysterectomy	Generalized metastases in 2 weeks, death following
Pepere	70	Multipara	14 mos.	Necrotic material 2 mos.	Severe hypogastric	Loss of flesh				Submucous fibroid plus infection, gangrene or malignancy		
Same	70	Multipara		Yes	Yes	Heavy feeling in lower abdomen			Cervix long and thick; parametria infiltrated	Carcinoma of the cervix		Death
Phillips	50	0	14 mos.	Necrotic material 2 mos.	Severe hypogastric	Loss of flesh; backache		Uterus size of 4 months' pregnancy		Submucous fibroid plus infection, gangrene or malignancy	Hysterectomy	Death, embolus
Pick	52	Multipara	Yes			Anæmia	Cervical polyp		Cervical polyp	Sarcoma of fundus after curettage	Vaginal hysterectomy	
Pohorecky	34	8	2yrs.						Snoutlike tumor, size of plum on posterior lip	Carcinoma or sarcoma of the posterior lip of cervix	Vaginal hysterectomy	Well 2½ years later

Rademacher	43								Tumor size of walnut on posterior lip			Autopsy only
Rimann	48	0	3 mos.	Yes	Yes				Cauliflower tumor on the posterior lip		Hysterectomy	Death 16th day
Same	36	5	3 mos.						Cauliflower growth, size of a small fist on posterior lip		Vaginal hysterectomy	Recovery
Same	67	3	Yes	Watery					Uterus slightly enlarged and fixed			
Same	31	5	2 mos.	Yes	Yes				Cauliflower growth on cervix		Vaginal hysterectomy	
Robb	62	5	Yes		3 weeks	Dull pain left leg; backache			Cervix flush with the vaginal wall; uterus fixed	Malignant disease of cervix	Cautery	Alive at end of 1 year
Sell	19	0	3 mos.	Yes		Dizzy—vomiting; in extremis						
Shaw	48		2 yrs.						Polypoid fibroma in cervix			Well 5 months later
Silberberg	64		Yes	Yes					Uterus double the normal size	Suspected carcinoma	Cautery	
Smith	38		4 mos.		Yes		2 cyst adenomata removed 2 years previously		Cervix and uterus negative		Hysterectomy	
Sperber	32	0	Yes	Yes	Yes	Headache			Tumor in cervix size of hen's egg		Hysterectomy	Recovery
Svoboda	34	3	18 mos.	Yellow					Polyp, size walnut, replacing anterior lip	Polyp	Vaginal hysterectomy	Death, peritonitis
Viana	50	3	3 yrs.	Yes					Uterus size of three months' pregnancy	Neoplasm of the corpus uteri	Vaginal hysterectomy	Recovery
Watson	58	1	1 yr.	Watery					Uterus normal size	Malignancy	Vaginal hysterectomy	Recovery followed later by squamous epithelioma
Willey			3 yrs.		6 mos.				Uterus enlarged		Hysterectomy	

TABLE III.—FURTHER DATA IN FORTY-ONE CASES FROM LITERATURE

Author	Uterine Size	Site of Growth	Size	Shape	Surface	Color	Consistency	Section	Cell Shape	Arrangement	Nuclei	Amount of Intercellular Substance	Origin Growth	Remarks
Amann		Posterior lip of cervix (thickened	Hazelnut	Not circumscribed sharply	Ragged	Grey yellow	Firm		Spindle polygonal	Around lymph vessels	Large	Small	Lymph spaces	
Barbour	3 months' pregnancy	Lower posterior wall	Large	Cyst	Tense—smooth	Yellow-white	(Of Wall) of fibroid	Caseous matter and fluid		Around blood vessels many of latter				
Same	5 months' pregnancy	Whole uterus	Large	Cyst	Smooth	Dark œdematous	Elastic	Purple with bright red areas plus thick chocolate fluid						
Barbour and Watson	3 months' pregnancy	Fundus	Large	Fibroid		Yellow-white	Brainlike	Hæmorrhage; necrosis		Radial about blood vessels, islands of tumor cells	Deeply stained		Lymph channels	Necrotic tissue
Beckham	3 months' pregnancy	General hyperplasia of uterus				Greyish red	Soft		Spindle	Closely packed around blood vessels. Cell nests		Very small	Blood vessels	Few cells free in vessel lumina
Bruetz	Small	Posterior lip of cervix			Bleeding		Friable		Central-circular. Outer are elongated	Knots and ribbons. Cell groups have central lumina	Deep stain, large		Lymph vessels	
Cova	Normal	Anterior lip		Fungoid	Spreading		Friable	Lardaceous		Many small spaces—resembling lung				
Curtis and Vanwerts	3 cocoanuts				Irregular		Resembling sarcoma, friable		Polyhedral	Concentric lamellæ around capillaries	Oval edge well defined		Lymph vessels	
Donald		Anterior lip		Rounded		White brown			Spindle	Alveolar				Much pigment in many cells (hæmatoidin)
Doran and Lockyer	2 fists	Walls and fundus		3 fibroids 1 cystic with pus					Small round	Cells rise from the outer coat of blood vessels — columns and patches				
Same	Above umbilicus	Left wall and sigmoid	2½ pounds	Fibroid						Collections of cells springing from the adventitia of blood vessels				
Duret	Slightly enlarged (adult fist size)	Cervical canal												Areas of fatty degeneration
Ewing	Enlarged	Anterior wall projecting into cavity	10 by 6 cm.	Polypoid				Tumor nodules in muscle	Polyhedral	Compact	Mitotic figures			Areas of necrosis

Gebhard		Cervix filling upper vagina	Fist	Round	Rough		Gangrenous and like fibrous polyp		Mixed tumor: connective tissue; smooth muscle; fat; cartilage; endothelium					
Gottschalk	6 months	Wall subserous	Large	Myomatous	Irregular				Polymorphic	Anastomosing columns of cells axial to blood vessels		Lacking in amount	Veins	
Graefe		Cervix	Apple	Cauliflower						Rings around lymph vessels	Deeply stained			
Grape	Enlarged	Anterior wall							Polygonal spindle	Alveoli plus central lumina	Large, clear, vesicular			
Hansen	Large abdominal tumor	Uterine wall			Irregular				Little protoplasm	Around blood vessels	Deep staining			
Huizinga		Anterior lip	Hazelnut							Groups—simulating a diffuse sarcoma			Endothelium of blood vessels	
Hurdon	Small	Anterior lip			Crater		Harder than adenocarcinoma		Cuboidal	Lunglike. Many tubules. No teat-like ingrowths		Small	Lymph spaces	Narrow zone of hyaline next to lumina of lymph spaces
Kirchgesener	Normal	Anterior lip	Walnut size	Polypoid	Irregular		Hard			Cells projecting into lumina			Lymph spaces	
Kroemer	Enlarged	Posterior lip					Hard friable		Spindle	Rings around small lymph spaces and cells in spaces		Lacking in amount	Walls of lymph vessels	
Same	Small	Posterior lip					Friable		Polymorphic	Knots — groups — and around lymph spaces				Many veins in cervix. Round-cell infiltration
Leith	Very large	Walls		Of fibroids					Irregular	Around capillaries		Small in amount		Many round cells
Marocco		Cervix								Around blood vessels. Cells in large masses.				
Same		Endocervix		Polypoid					Round, fusiform	Arborization of cells	Rich in chromatin	Lacking in amount		Degeneration
Same									Round, fusiform	Cords—alveolar arrangement	Clear			
Maunsell	Very large tumor, uterus normal	Body, right horn							Small cells	Small alveoli, masses of cells	Round			
McFarland	Enlarged	Posterior superior surface of body.	Large		Ragged					Relation to lymph spaces definite. Giant cells present				Necrosis. Hyaline degeneration

TABLE III.—*Continued*

Author	Uterine Size	Size of Growth	Size	Shape	Surface	Color	Consistency	Section	Cell Shape	Arrangement	Nuclei	Amount of Intercellular Substance	Origin Growth	Remarks
Pozzi		Cervix					Fleshy	Punctate hæmorrhages	Large, round	Alveolar—like a cyst adenoma	Large	Small amount	Lymph Blood vessels occupied by groups of cells	
Phillips	3 months	Uterine cavity	Golf ball				Brainlike		Polypoid. Round spindle cells	In masses. Concentric growth about blood vessels and lymph spaces	Rich in chromatin	Small amount		
Pick	Enlarged	Uterine cavity submucosa	Egg				Firm						Endothelium of the lymph spaces and capillaries	
Pohorecky	Enlarged	Posterior lip	Plum	Snout-like	Rough, bloody		Firm	Hard greyish white lobules	Cuboidal and polygonal		Small, dark	Lacking in amount	Lymphspaces	
Rademacher		Posterior lip	Walnut				Spinal cord	Reddish white		Groups and nests. Concentric arrangement			Lymphvessels	
Riemann		Posterior lip		Cauliflower			Brain		Spindle	Concentric to lymph vessels				Many plugs of endothelial cells in veins
Same		Posterior lip	Small fist	Cauliflower		Yellow-brown	Friable		Polygonal				Lymph vessels	Many blood vessels and veins. Round cell infiltration
Same	Slightly enlarged								Large	Alveolar	Large and chromatic	Small		
Same		Cervix		Cauliflower					Spindle	Around blood vessels	Large, round, chromatic			
Robb		Cervix							Oval spindle	Masses	Many	Small		Giant cells. Many clefts
Sell	Normal	Anterior vag. wall and cervix. Close rel. to bladder					Friable				Chromatic, small		Lymphspaces	Hyaline rings
Shaw		Cervix		Polyp						Around blood vessels. Radially				

Silberberg	Double normal size		Of normal uterus		Dirty grey	Firm	Point of calcification	Alveolar		Ends of blood vessels	Hyaline degeneration
Smith		Fundus				Soft, friable		Around blood vessels			Infiltration of uterine muscle
Sperber		Cervix	Hen's egg			Cartilage		Blood vessels thick walls	Round — cuboidal, polymorphic	Lacking	
Svoboda	Normal	Anterior lip	Walnut	Polyp.	Irregular			Strands, knots, alveoli, thickening of walls of lymph and blood vessels	Dark		Small round-cell infiltration
Viana	3 months					Soft, fleshy		Numerous spaces. Groups of cells	Large—oval	Lacking	
Watson	Normal	Posterior wall. Middle of body						Radial arrangement around blood vessel			Areas of necrosis
Willey	Enlarged	Uterine cavity				Fatty					

only 19. The average age was 44. From the standpoint of the decades of life, it is interesting to note that the largest number for any decade occurred between the ages 30 and 40. Of these, two-thirds occurred in the first half of that decade. This brings, then, the period of greatest frequency to a point shortly before the menopause. Table I gives the occurrence of cases according to decades.

Parity. This feature was mentioned 35 times. The greatest number of pregnancies was 12. The average was 3. Eight of the cases, or almost 25 per cent, had never been pregnant. In two additional cases multiparity was stated, but the exact number of pregnancies was not given. The number of pregnancies, then, did not seem to have any direct bearing on this condition. A strikingly large number had never been pregnant.

Metrorrhagia. This symptom occurred with greater frequency than any other. It was noted in 35 cases in a series of 42, where any mention was made of the menses or any bloody flow. This represented 83 per cent. The duration, which was noted in 28 cases, varied from 2 days to 6 years. The average was 14 months.

Leucorrhœa and discharge other than blood was mentioned in 21 cases, or 43 per cent. The duration varied from 6 weeks to 5 years. The average was 18 months. Disagreeable odor was mentioned in only 4 cases. The discharge was described as watery in 4 cases, and as yellow in 4.

Pain. This was mentioned in 16 cases, or 33 per cent. It was not constant in character or amount. The sensations described included backache, pain, and smarting around the vagina, lancinating pains in the groin, and pain in the bladder region.

Abdominal tumor. In 10 cases there was present swelling which the patient herself had noticed. In two other cases the uterus had reached the size of a 4 months' pregnancy. In one case the abdominal swelling had been increasing for 7 years. In 2 cases the enlargement had been going on for 2 years. In only 1 case had there been any recent rapid increase in growth. In one a fistulous tract had formed below the umbilicus, and was discharging pus.

General systemic disturbance. In three cases anæmia was noted. In 4 cases weakness was recorded. In 4 cases there was loss of flesh, and in one there was mental disturbance.

Vaginal examination. This was made in 38 cases. In 24 cases, or about 63 per cent, the cervix was the site of the lesion.

Pre-operative diagnoses. Definite diagnoses were made in 30 cases. In only 2 cases was the diagnosis of sarcoma made. Myoma was diagnosed 9 times; in two of these cases degeneration was noted, in two it was complicated with malignancy, and in one by suppuration. In 10 cases the condition found was malignancy of the cervical region. These represented the chief diagnoses made.

Subsequent history. This was recorded in 33 cases. Death was the result in 15 of these. Twelve deaths occurred within a month. The majority of these were from peritonitis. Three, however, died as a result of metastases. These occurred at the end of 18 months, 8 months, and 6 weeks, respectively. Ten cases were reported well at periods varying from 5 months to 6 years, the average length of time during which the cases were followed up being 2 years and 4 months.

In Table III we find the following information:

Uterine size was mentioned 31 times. It was normal in 8 cases, mentioned as very large in 8 cases and variable in size in 15 cases.

The site of the growth was mentioned in 43 cases; of these, the cervix was the seat in 25 cases, or 58 per cent. The posterior lip was mentioned as point of origin in 8 cases and the anterior lip in 7 cases. The remaining cases were involved in various other parts of the body.

The shape and size of the tumors varied greatly. They divided themselves into small, fungated growths in the cervix, and malignant degenerations of variable sized myomata.

The consistency was mentioned 26 times. It was reported as soft, or brain-like, in 9 cases and as firm in 9 other cases.

Cell shape was given in 27 cases: spindle-shaped in 10 cases; polygonal in 9; round in 4, and cuboidal in 2. In many cases the cells were described as being quite variable in shape, but the types mentioned predominated.

Arrangement of cells: This matter was discussed in 41 cases. In 9, an alveolar arrangement was noted. In 6, islands or masses of cells were described. In 7, the cells were described as being arranged radially to the lymph spaces. In 15, the arrangement was noted as being around the blood vessels. In two of these cases the cells were arranged around both the lymph spaces and blood vessels.

A lack of intercellular substance was noted in 13 cases. The origin of the growth was described as the lymph spaces in 11 cases, as the blood vessels in 4 and as both in 2.

Other special features include the presence of giant cells, hyaline degeneration, small, round-cell infiltration, areas of necrosis, the presence of pigment, fatty degeneration, an increase in the number of blood vessels in the affected part.

The following case is reported from the wards of the University Hospital, from the service of Dr. John G. Clark, to whom the writer is indebted for the privilege of presenting the case.

M. D., Gyn. No. 2150, Hosp. No. 2810, age 41, single and white, came to the hospital complaining of painful micturition, attacks of retention starting 3 years prior to admission, recently hæmaturia at the end of micturition, an unusual amount of discomfort recently with the menses.

The family history was negative. The menses began at 16, lasted 7 days and periods occurred every 28 days. They were associated with no pain and only occasionally slight leucorrhœa.

Present illness. Three years prior to admission after a day's work of heavy lifting, she developed acute retention, associated with much pain, and lasting about 10 hours. At the end of this time she had a sensation in her abdomen as though something had given way, immediately after which she passed half a chamberful of urine. Bladder irritability and frequency had preceded this attack for some time. The subsequent attacks of retention were followed by frequency, and the whole aggravated by being on her feet. This condition lasted for 3 or 4 months, when her first attack of hæmaturia came on at the end of micturition. In all she had five attacks of hæmaturia, the last two just prior to admission being very profuse. Moderate dysmenorrhœa developed during the last two or three periods.

Physical examination The patient's general condition showed nothing noteworthy except an irregular and intermittent heart action. The uterus could be felt above the symphysis, apparently covered with small nodules. *Vaginal examination*

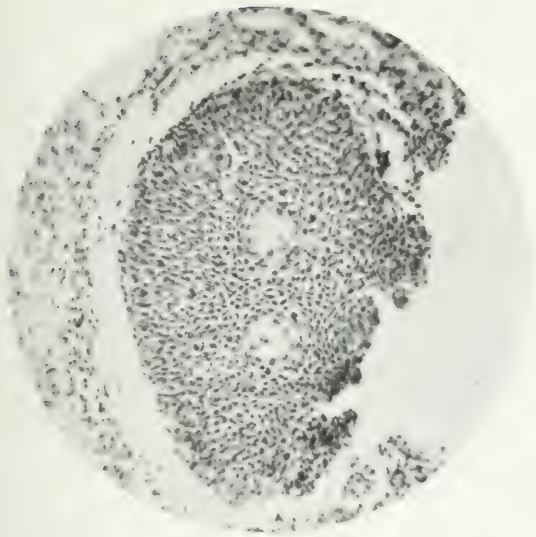

Fig. 1. Section from wall of the uterus showing the concentric arrangement of the cells around the blood vessel.

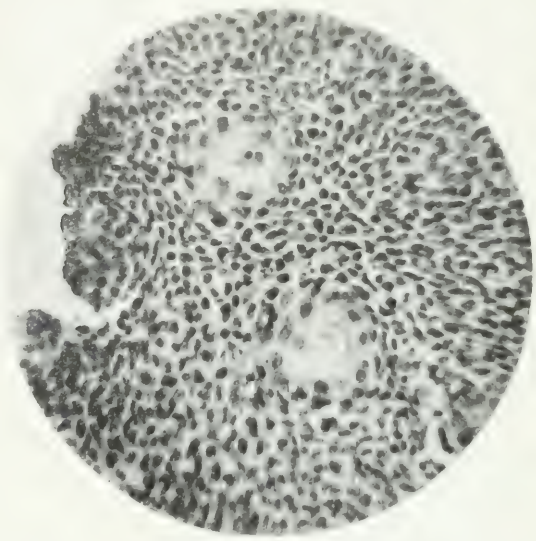

Fig. 2. Section from wall of the uterus under higher power, showing round and spindle cells.

showed a hard mass in the cul-de-sac of Douglas and encroaching on the rectum. The cervix was small, pushed to the left and contained a polypus. The uterus seemed to be retroverted, and fibrous nodules could be outlined. The mass in the cul-de-sac was very dense and extended into the right broad ligament. The urine showed much albumin and many pus cells, but no evidence of any red blood corpuscles.

Operation by Dr. John G. Clark. An intraligamentous tumor was found on the right side infiltrating the summit of the bladder. The tumor was enucleated. The bladder was resected and a suspension of the uterus performed. A clinical diagnosis was then made of a sarcomatous degeneration of a myoma. The patient died 4 days after the operation of peritonitis.

Pathological findings. Microscopically the specimen consisted of a tumor and a portion of the involved vesical wall.

The tumor was rounded in shape, with a diameter of 10 centimeters. As it came to the laboratory it showed no capsule. The surface of the neoplasm was rough, homogenous, and pinkish-white in color. It was soft and almost brain-like to the touch. On section, many cystic areas were found. Some of these were actually cysts 1 to 2 centimeters in diameter. Everywhere serum followed the knife. Some of the degenerated and cystic areas were yellowish, others dark and necrotic, while one of the largest was dark purplish-red. The tumor was very vascular and suggested a sarcoma.

Vesical portion: A small rounded lobulated portion of the tumor had penetrated the entire thickness of the bladder wall, and was present in the bladder. This tumor had a short pedicle, and was soft, purplish-red, and strongly suggested malig nancy. The vesicle wall was generally thickened (1 by 1.75 centimeters), hard, and nodular to the touch, the mucosa thickened and deeply congested.

Microscopic findings. All the sections show the same general characteristics. There is a framework of very fine, delicate fibrous tissue, scattered throughout with round and spindle cells. These vary greatly in size and staining properties. The majority of these cells take the hæmatoxylin stain deeply and

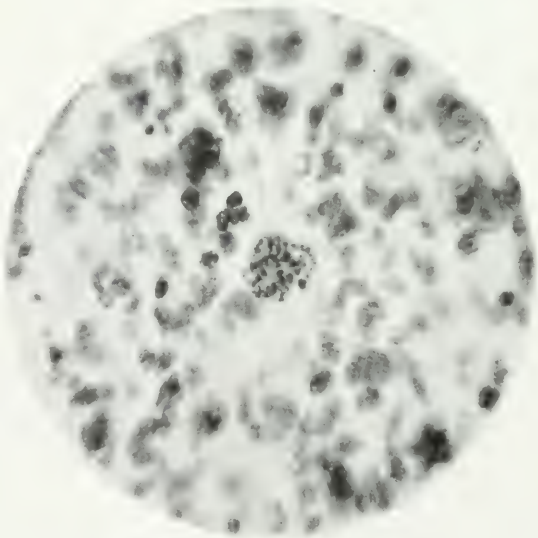

Fig. 3. Same, under oil immersion, showing presence of giant cell.

have large deeply stained nuclei. Cell division is frequently seen. A few giant cells are present. In some areas the cells are scattered indiscriminately about the field, while in others there is a distinct alveolar arrangement. In almost all of the cases, the center of the alveolus contains a blood vessel, and it is from the endothelium of these that the above-described cells take their origin. Some fields show this plainly, while in others it is less distinct. Many areas of hyaline degeneration are present. Considerable free blood is seen throughout the section. Sections from the bladder show a similar histological picture.

SUMMARY

1. The point of origin and the exact classification of the endotheliomata are still considered doubtful by many investigators.

2. The writer feels that the term is sufficient and should be used.

3. Of the female pelvic organs the ovary is most frequently the seat of growth, and the uterus is more often attacked than the literature would indicate.

4. Pre-operative clinical diagnoses have never been made.

5. The gross specimen removed at operation has no pathognomonic characteristics.

6. The diagnosis rests entirely upon the histological picture.

7. The uterine endothelioma is highly malignant and is frequently metastatic.

8. The treatment is that of malignancy.

9. The period of greatest incidence is between the ages of 30 and 40.

10. The most frequent symptom is hæmorrhage.

11. The cervix is attacked more frequently than the fundus.

12. Endotheliomatous degeneration of pre-existing myomata is not infrequent.

13. The mortality rate is high.

14. A case of endothelioma of the uterus is presented.

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SYPHILIS OF THE UTERUS AND ADNEXA[1]

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SYPHILIS of the uterus is a comparatively rare affliction, especially when one excludes the primary lesions occurring on the cervix. According to Prentiss (1) there are only 50 articles in the Surgeon General's Library up to 1914. Dr. D. S. Lamb, quoted by Prentiss, found only one specimen in the Army Medical Museum. In spite of the paucity of the literature on this subject a large variety of pathological lesions have been reported as secondary or tertiary lesions of the body of the uterus and the adnexa. The proof to substantiate the diagnosis of syphilis in these organs is, however, inadequate in most of the reported cases.

SYPHILIS OF THE CERVIX

Primary lesions. Gellhorn and Ehrenfest (2) believe that the primary lesion of the cervix is the best known and most common type of syphilitic involvement of the female internal reproductive organs. According to them, cervical chancres occur in about 1.5 per cent of all primary lesions of female genitalia, while Oppenheim, according to Frank found it to be 8 per cent and Ozenne (3) 4 to 10 per cent. This discrepancy of the frequency is attributed by Ozenne to the comparatively few examinations of the cervix in the early stages of syphilis; also to the relatively few symptoms which are produced in the patient by this lesion. An additional factor, however, is that chancres of the cervix are protected from irritation and friction, so that their course is quite rapid and the lesion produces very little necrosis or ulceration. Under usual conditions, the chancres heal quite readily and leave practically no scar as the result of their presence.

Ozenne, in reviewing the literature and his own personal cases in his recent monograph on *La Syphilis de l'Utérus et de ses Annexes*, found that the anterior lip was involved twice as frequently as the posterior and that in about half of the cases both of the lips were involved; in many cases multiple lesions occurred. He attributes the more frequent involvement of the anterior lip to the normal anteflexion and anteversion of the uterus. He divides the pathological processes in the production of the chancre into 4 stages: First, that of the incubation, of which practically nothing is known. Second, the period of onset, which occurs from 25 to 30 days subsequent to exposure; during this stage only a slight hyperæmia may be recognized. This stage also has been rarely observed. Third, the period of acme, during which the chancre assumes a definite form and appears either as an erosive, or papillary erosive process or as an ulcerating lesion. The erosive form is the usual type; in this there is a shallow, indolent lesion with moderate induration of the base and with the production of only a slight amount of secretion. The ulcerating form is very rare and may produce extensive ulceration of the entire cervix. This lesion is usually red in color and may be easily caused to bleed. There also is an associated hypertrophy of the cervix and marked induration. It is in this stage that the primary lesion of the cervix is confused with carcinoma. Adenopathy frequently occurs and may involve either the inguinal or the iliac glands. He emphasizes the point that the occurrence of enlarged inguinal glands without visible involvement of the external genitalia should arouse one's suspicion of the existence of a primary lesion of the cervix and especially so when there are associated herpetic lesions of the vulva. Fourth, the period of repair; this is usually quite rapid and leaves practically no scar. It lasts ordinarily from 3 to 4 weeks after the period of acme.

Frank (4) describes a special peculiarity of chancres of the cervix of the pregnant uterus, in that these lesions may persist up to a period of 5 months and may produce very extensive induration which may prevent spontaneous delivery of the child. Cullen (5)

[1] Presented before the Chicago Gynecological Society January 19, 1923. (For discussion see p. 99.)

emphasizes the marked induration of the base and the occasional occurrence of extensive necrosis. Liegner (6) points out that frequently our attention is attracted to the healing or healed chancre by the occurrence of secondary lesions and symptoms of early syphilis elsewhere in the body.

Secondary lesions. Ozenne believes that the secondary lesions of the cervix should be called mucous syphilides and they are usually identical with secondary lesions which involve the other mucous membranes. Fornier, according to Ozenne, found 25 cases of secondary lesions of the cervix in 522 cases of secondary lesions about the vulva. Gellhorn and Ehrenfest reported 8 cases. The latter authors divide these lesions into macules, papules, and ulcers. These forms probably represent different stages of the original macular lesions. They were able to demonstrate treponemas in practically all the various stages described.

Ozenne divides the secondary lesions into five forms: First, the erythematous form, which is usually of a red color and may involve either a part or the entire surface of the cervix and resembles an acute inflammatory lesion. Ordinarily, this type lasts for about 15 days. Second, the erosive form, in which there is a superficial erosion of variable size. The base is flattened and may have a pale red color; the lesion frequently begins as the chancre disappears. Third, a hypertrophic ulcerative form, in which the lesions first undergo a hypertrophic process, which may involve the entire cervix; the latter frequently has a violaceous color. The cervix at first is soft and slightly depressed but subsequently becomes indurated and undergoes ulceration, but with very slight production of granulations. Fourth, the papular syphilide which is the most frequent form and consists of papules of varying size. These may be multiple and they usually exhibit a tendency to coalesce. This form also may undergo ulceration. Fifth, the ulcerating syphilide, which consists from the beginning of a diffuse superficial ulceration of irregular shape with a serpiginous border.

Cullen describes the papular ulcers as being elevated above the level of the cervix and covered with a whitish or yellowish necrotic tissue. This point is also emphasized by Gellhorn and Ehrenfest as being quite characteristic of secondary syphilitic lesions of the cervix.

Tertiary lesions. Gellhorn and Ehrenfest had 6 cases of tertiary involvement of the cervix. These authors concluded that the essential lesion is a gumma which undergoes necrosis and ulceration. If the tissue proliferation predominated they considered the lesion a gumma, whereas, if retrogressive processes predominated they considered the lesion a gummatous ulcer. The cervix is usually of increased consistency and the lesions are quite firm. However, when the gummata undergo retrogressive changes they become soft and may produce a typical punched out ulcer. These ulcers usually have a yellowish appearance and may form a serosanguineous or mucopurulent exudate. During the process of healing there frequently is extensive scar formation.

Ozenne describes two forms: First, the gummatous type, which may cause diffuse gummatous infiltration involving the entire cervix and producing an irregular surface. This form is usually associated with considerable sclerosis and in some cases this process spreads to the adjacent body of the uterus. In the isolated gummata, the cervix may be studded with small solid tumors which may involve only one lip of the cervix. These may undergo dissolution and disappear or what is more frequently the case, they undergo necrosis and ulceration. Second, the sclerotic form, which may develop on pre-existing primary, secondary, or other tertiary lesions. Early, there are hypertrophic changes in the cervix, causing it to become enlarged and quite firm. This process may go on for several years but later there is atrophy and considerable fibrosis. Subsequently there may be marked stenosis of the cervical canal; when this does occur it usually gives rise to dystocia.

Cullen considers that gummata are quite rare. The tertiary ulcers that occur are usually elliptical, sharply defined, and covered with yellowish exudate.

Prentiss considers that the most common syphilitic lesion of the cervix consists of peri-

vascular round-cell infiltration, arteritis, endarteritis, and fibrosis.

SUMMARY OF SYPHILIS OF THE CERVIX

Ozenne concludes that in order to make a diagnosis of syphilis of the cervix there are several essential points to be considered: First, a careful clinical history and physical examination; the latter should include the use of the speculum in order directly to observe the cervix. Second, the finding of the treponemas in the lesions. Third, the development of a positive Wassermann reaction in the blood. Fourth, the evidence of secondary lesions elsewhere in the body. Fifth, the therapeutic test, which causes the lesions to disappear under antiluetic treatment.

Gellhorn and Ehrenfest, in summarizing this variety of syphilis, include the following essential general facts: First, there is little secretion from the syphilitic lesions of the cervix, except in the tertiary ulcers or necrotic gummata. Second, there is little pain, either spontaneous or resulting from direct trauma. Third, luetic lesions of the cervix in general occur some distance from the external os, which is rarely the case with nonspecific ulcers of the cervix. Fourth, the syphilitic ulcers are usually covered by a film-like deposit, which may be wiped off easily, and exhibit a fatty lustre. These ulcers in addition are usually sharply outlined. Fifth, there is very little, if any, inflammatory reaction about the syphilitic ulcers.

SYPHILIS OF THE BODY OF THE UTERUS

Primary and secondary syphilis of the body of the uterus has been rarely observed. Norris (7) believes that the infrequency of primary lesions in this region is due to the fact that treponemas usually show a predilection for the squamous epithelium.

Tertiary lesions. Franceschini, quoted by Gellhorn and Ehrenfest, consider the varieties of tertiary syphilis under the following headings: First, syphilitic arteritis, which may cause marked arterial change, consisting either of diffuse arteritis or perivascular, round-cell infiltration. In this form, the uterus does not increase in size or shape, and hæmorrhage is frequently associated with the vascular lesions. Second, sclerosis of the myometrium, which may lead to generalized induration of the uterus with considerable proliferation of connective tissue; the latter may subsequently undergo hyalinization. Third, hypertrophy and induration of the uterus, which may cause it to become moderately enlarged and quite indurated. Fourth, atrophy of the uterus, which usually involves both the myometrium and endometrium, so that the uterus becomes a very small, hard organ.

Hoffman, according to Frank, reported a case of a woman who died 3 months postpartum in whom the endometrium was transformed into a gummatous layer several centimeters thick. Gummata were found in other organs. Askanazy (8) emphasized the fact that gummata of the uterus are frequently very atypical in that there is usually a predominance of hyperplasia of fibroblasts resulting in the production of a fibrous ground work in which, in spite of the necrosis that may occur, remnants of the pre-existing structure may be recognized. In addition, he described marked lymphocytic and plasma-cell infiltration which may be perivascular and perilymphatic in distribution. There may be diffuse infiltration of both the endometrium and myometrium with the above cells. Findley (9) concluded that syphilitic arteritis is probably the most prominent and the only evident lesion of syphilitic involvement of the uterus. This conclusion is corroborated by Gellhorn and Ehrenfest.

Ozenne describes two main types of tertiary syphilis of the uterus: First, the ulcerating gumma, which may be an infiltrating gummatous lesion in which there is diffuse infiltration of the uterus by small gummatous lesions. This causes a marked increase in the size of the uterus, sometimes approximating in size the head of a fetus. There may also occur single gummata, which ordinarily are small tumors which may undergo subsequent necrosis and softening, and produce the typical gummatous ulcer. Second, the sclerotic form in which the essential lesions are those of angiosclerosis and fibrosis of the myometrium. Morisani, quoted by Norris, believes that angiosclerosis of syphilitic origin

is quite common. McFarland (10) considers that chronic diffuse syphilitic endometritis is rather common. This opinion is also held by Norris who describes thickening of the stroma of the endometrium and changes in the glands. Gellhorn and Ehrenfest, however, conclude that the endometritis frequently seen in syphilitic women is not characteristic of syphilitic involvement.

Bordarrampé (11) had two cases which he considered as gummatous lesions of the uterus in which the Wassermann reaction was positive and the uterus returned to normal size under antiluetic treatment. According to Sosnowski (12) the tertiary lesions of syphilis of the body of the uterus frequently are confused with carcinoma involving the body of the uterus. Many authors do not believe that the simple abatement after antiluetic treatment of symptoms, such as hæmorrhage, increased size of the uterus and fibrosis, indicates syphilitic involvement of the uterus, and that the scant histological reports do not always substantiate the diagnoses.

SYPHILIS OF THE ADNEXA

There have been practically no conclusive cases in which syphilis has involved the tubes and ovaries. Gellhorn and Ehrenfest conclude that it is possible that the tubes and ovaries may become involved, but they have never seen any pathological or clinical material either in their own cases or on record to substantiate the diagnosis of syphilitic involvement. Costano (13) believes that some of the tubo-ovarian abscesses are probably of luetic origin. He, however, offers no proof to substantiate this, neither do other authors corroborate his findings. Treponemas have never been demonstrated in the acquired syphilis of the adnexa. Many lesions of the ovaries such as simple enlargement, syphilitic oophoritis, sclerosis and ovarian gummata have been described as expressions of secondary and tertiary syphilis, but Gellhorn and Ehrenfest have not found any evidence to substantiate these diagnoses.

Review of the literature leads to the conclusion that in most of the reported cases of syphilis of the body of the uterus, the evidence to establish the luetic nature of the described processes is inadequate. Typical gummatous lesions may probably be accepted without question. The reported cases of syphilis of the adnexa must be viewed with considerable skepticism. A case with early involvement of both the body of the uterus and the ovary, the nature of the lesion being established by the demonstration of the specific organism in both situations, is, therefore, considered worthy of record.

Mrs. D., age 38, entered Michael Reese Hospital on August 16, 1922, and complained of uterine bleeding. Three years before admission, the patient was curetted because of uterine bleeding. Since that time she has had one child which is 8 months old. The present attack of uterine hæmorrhage began about 2 months before admission and continued for 13 days. There was then a cessation of the bleeding for a period of 10 days. Subsequently, she has had irregular bleeding without relation to the menstrual cycle. The bleeding had at times been very profuse and has caused symptoms referable to a marked secondary anæmia. She had typhus at 8 years and smallpox at 10. There have been 11 pregnancies; 6 of the children are alive and 5 are dead. The five children that died were all of normal delivery and lived for varying ages of from 2 weeks to 18 years. The causes of death are unknown. There were no miscarriages. Menstruation began at 14, was regular and lasted 5 to 6 days. The periods, however, have been irregular since the last child. The family history is essentially negative.

The physical findings on admission revealed a moderately well nourished, white female of about 38 years of age exhibiting a marked pallor of the mucous membranes. The examination of the head, neck, thorax, and abdomen was essentially negative.

In the bimanual examination, dark fluid blood was found in the vagina. The perineum was moderately relaxed. The cervix had a bilateral laceration. The posterior lip was ulcerated and there was marked induration and thickening of the entire cervix. The surface was finely granular to palpation. The fundus was smooth, moderately enlarged and in the retroposition, but freely movable. There was moderate induration in the broad ligaments and small irregular masses were palpable to the side of the uterus. The left ovary was palpable. The direct observation of the cervix showed a mottled, irregular, ulcerated surface covered with a grayish red exudate.

The laboratory findings were those of a severe secondary anæmia. The urine contained albumin, blood cells, and pus, probably due to the admixture with the exudate from the uterine cavity.

The clinical diagnosis was carcinoma of the cervix and the case was considered operable.

A panhysterectomy was performed on August 19, 1922. The gross findings are described in the pathological report below. The patient made an uneventful recovery and left the hospital.

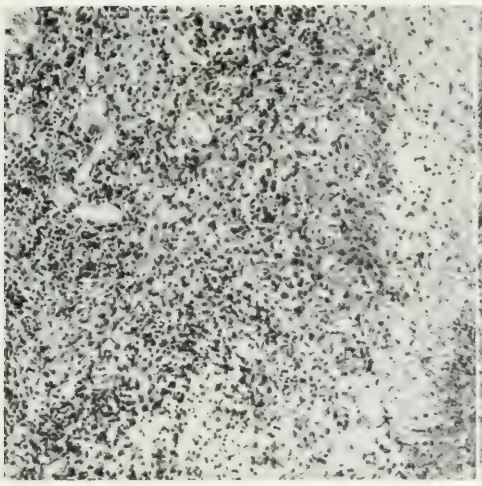

Fig. 1. Section through the cervix, showing at the right, the superficial ulceration covered by a fibrino-hæmorrhagic exudate. Beneath this layer the stroma of the cervix is found to be diffusely infiltrated with lymphocytes. There are many newly formed vessels extending throughout the section.

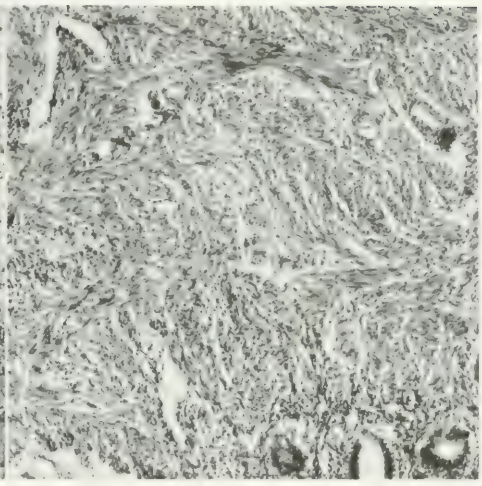

Fig. 2. Low power magnification of section through body of uterus, showing the endometrium at the bottom and the myometrium at the top. There is a diffuse infiltration of both layers with lymphocytes and plasma cells. The glands of the endometrium are somewhat hyperplastic. There is a dilated Y-shape lymphatic vessel to the left.

About 7 weeks after being admitted, the patient returned to the dispensary with very extensive secondary syphilitic lesions of the skin. A Wassermann test was made and found to be 4+ positive. Further inquiry was made about the condition of her husband and it was then found that he had had a primary lesion a few months previous.

Pathological findings. Gross examination—Uterus: The uterus was enlarged, measuring 6 by 4 by 2.5 centimeters. It was of a red color, of rather soft consistency, and very friable. The cervix was slightly indurated and had a bilateral laceration. It was thickened, and on the posterior lip there was a superficial ulceration which was covered by a red granular exudate. A bisection of the uterus revealed the uterine cavity somewhat enlarged. The endometrium was thickened, œdematous, and of a pink color. The myometrium was fibrous in character and the larger vessels displayed definite sclerosis. The perimetrium was also thickened and fibrous adhesions were attached to it.

Salpinx: The salpinx each measured about 6 by 0.4 centimeters. The fimbriated ends were patent and readily admitted a probe. The lumen was patent throughout and there was no exudate. There was some fusion of the individual folds of the mucosa.

Ovaries: The left ovary measured 4.5 by 2.5 by 1.5 centimeters. It was rather cystic to touch and bisection revealed numerous follicular cysts of varying sizes, several whitish scars and considerable fibrosis. The right ovary measured 2.5 by 1 by 0.8 centimeters and was converted into markedly fibrotic tissue.

Microscopical examination: Cervix (Fig. 1): The squamous epithelial covering was almost entirely desquamated and in its place there was a dense fibrino-hæmorrhagic exudate containing numerous lymphocytes and polymorphonuclear leucocytes. Beneath this exudate, there was a rather highly vascularized tissue containing many newly formed blood vessels. These was, in addition, a diffuse infiltration of lymphocytes and plasma cells in this region and throughout the cervical tissue. There was no definite tendency for perivascular lymphocytic infiltration.

Body of the uterus (Fig. 2): The glands of the endometrium were very markedly hyperplastic and tortuous. They were lined by a single layer of columnar epithelium. Throughout the endometrium there was a diffuse infiltration of lymphocytes and plasma cells. This cellular reaction was a very extensive process. The myometrium (Fig. 3) was diffusely infiltrated throughout with similar cells. This cellular infiltration separated the individual muscle strands but had no definite tendency to a perivascular distribution. The reaction in the myometrium was most marked immediately beneath the endometrium, but the process, however, involved the entire thickness of the myometrium. There was considerable increase of fibrous connective tissue between the muscle fibers, some of which had undergone hyalinization. The vessels in general were sclerotic, but there was no definite evidence of arteritis present.

Salpinx: There was a fusion of many of the folds of the mucosa and an increase of fibrous connective tissue of the stroma. The muscularis was slightly thickened and fibrous. The serosa was thickened and contained many newly formed blood vessels. There was no exudate in the lumen.

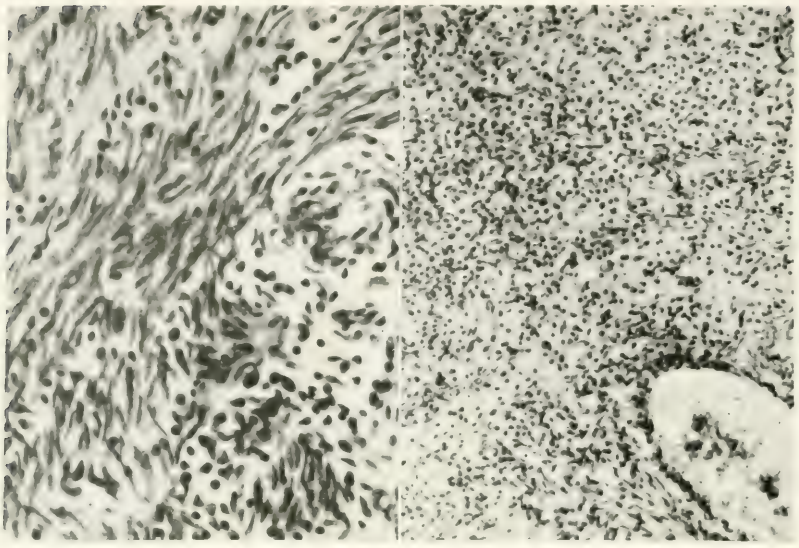

Fig. 3 (at left). High power magnification of the section through myometrium, showing the characteristic cellular infiltration. The muscle bands are separated by the lymphocytic infiltration and œdema of the interstitial tissue.

Fig. 4. Low power magnification of section through the ovary, showing diffuse infiltration with lymphocytes and plasma cells. At the top there is corpus luteum tissue in which the cellular infiltration is most marked.

Ovary: The larger left ovary (Fig. 4) contained numerous corpora albicantes and one corpus luteum. In the latter there was a central hæmorrhage, and an extensive infiltration of it by lymphocytes and plasma cells. The corpus luteum tissue itself had undergone only partial regression. The stroma elsewhere in the ovary contained a slight infiltration with lymphocytes. There was a generalized fibrosis of the ovary and a marked sclerosis of the arteries.

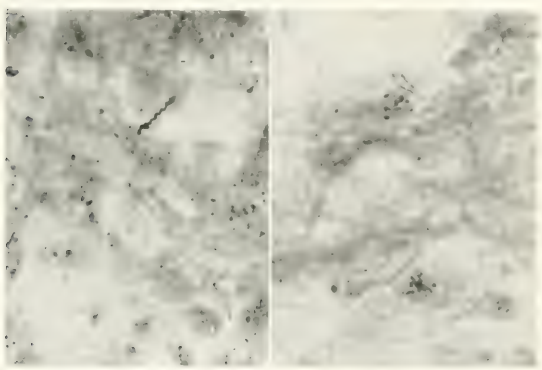

Fig. 5 (at left). Section through the myometrium stained by the Levaditi method, showing one distinct treponema in center of field and many smaller fragments throughout section. Several treponemas in field are not in focus.

Fig. 6. Section through corpus luteum of the ovary stained by the Levaditi method, showing two treponemas lying parallel to each other just above the center of the field.

The pathological diagnosis made as the result of the above findings was:

Chronic diffuse interstitial endometritis, metritis, and perimetritis;

Chronic superficial ulcerative endocervicitis;

Left cystic oophoritis;

Chronic inflammatory reaction of the corpus luteum in the left ovary;

Chronic catarrhal salpingitis and perisalpingitis.

Sections of the cervix, body of the uterus and ovaries were stained by the Levaditi method. We were able to demonstrate many treponemas throughout the cervical tissue, a considerable number in the myometrium (Fig. 5) and an occasional one in the corpus luteum of the left ovary (Fig. 6) and in the ovarian stroma.

Syphilis of the uterus, as described in the literature, produces marked variation in its pathological aspects, making it very difficult to establish definite histopathological principles for the lesions produced. Our specimen is the only one among 1366 uteri removed over a period of 13 years at Michael Reese Hospital, in which we were able to satisfy ourselves that we had a definite case which exhibited conclusive proof in establishing the diagnosis of syphilitic involvement of the uterus.

The lesion of the cervix was probably a late manifestation of a chancre and should be included in the erosive form of the early secondary lesions described by Ozenne. There was no evidence of a primary lesion of the external genitalia to cause one to conclude that a chancre was present or had involved these tissues. The glandular enlargements that were palpated in the parametrial tissues would also substantiate the presence of the chancre of the cervix.

The histological findings in the body of the uterus and ovaries brings up the question of the method of dissemination of the treponemas into these tissues. There are essentially two possibilities for this method of invasion: First, the body of the uterus and the ovary might have become infected as the result of a generalized blood invasion by the treponemas, which secondarily became localized in these two organs among many others. Second, that the process was one of lymphatic dissemination into the body of the uterus and ovaries from the chancre of the cervix. It is impossible to determine which of the above methods ensued, but we believe that the latter was the method of invasion because of the lack of definite arteritis and perivascular lymphocytic infiltration, and also because the secondary cutaneous lesions developed at a later period.

If this case is typical for early syphilitic involvement of the body of the uterus and ovaries, what may one expect in later stages? Are generalized angiosclerosis of the uterine vessels and diffuse fibrosis a terminal stage of earlier syphilitic involvement, such as was found in our case? We grant the possibility that many of the conditions described in the literature as syphilis of the uterus may be the end-result of early syphilitic involvement. But there arises at once the difficulty, as all experienced gynecologists have recognized, that changes in the vessels are quite frequent and of extreme gradation, thereby making it impossible in the uteri that have undergone many involutions subsequent to pregnancies, and in those the seat of tumors, to determine whether or not the arterial and interstitial changes are luetic or are the result of other and non-specific processes.

Syphilis of the adnexa is also very rare and the same discussion arises as to whether or not one may make the diagnosis on late findings of fibrosis and arterial changes. In our case we found diffuse lymphocytic infiltration which was most marked in the corpus luteum tissue. The more marked involvement of the latter, as compared with the rest of the ovary may be due to the rich vascular supply of corpora lutea. We believe that the conclusions given above may well represent those that one may draw for syphilis of the ovaries.

SUMMARY

Syphilis of the body of the uterus is rare. For most of the lesions which have been described as luetic, the specific character has not been definitely established and appears doubtful. Gummata have been reported; these lesions may probably be accepted as luetic, in spite of the fact that treponemas have not been demonstrated in them.

A case of early diffuse syphilitic involvement of the body of the uterus is described. The character of the process was established by the presence of the specific organism in the cellular tissue which separates the muscle bundles.

The lesion of the body was apparently secondary to a chancre of the cervix. Involvement of the body probably occurred by direct interstitial invasion from the primary lesion.

Adnexal lesions, the syphilitic character of which has been definitely proven, are even rarer than those of the body of the uterus. Chronic vascular and diffuse fibrotic processes have been reported as of luetic origin, but most of these must be excluded because of lack of evidence.

In the case reported, a corpus luteum and the surrounding stroma of the ovary were the seat of lymphocytic infiltration. Treponemas were present in this tissue, establishing the specific character of the inflammatory process.

That the involvement of the body of the uterus and of the ovary occurred early is indicated, not only by the cellular character of the inflammatory reaction, but also by the development of typical secondary cutaneous syphilides 7 weeks after the onset of the

first local symptoms. The blood Wassermann reaction was strongly positive when the skin lesions appeared. The age of the patient, a previously normal child-bearing history, vaginal bleeding, and the gross appearance of the cervix on direct visual examination led to a diagnosis of epithelioma of the cervix.

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ATROPHY OF THE LIVER WITH NODULAR HYPERPLASIA[1]

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ACUTE or subacute atrophy of the liver is of some interest to the surgeon, first, because the symptoms occasionally lead to unnecessary and unfortunate exploratory operations, and, second, because the operative findings in such cases are likely to be wrongly interpreted. Two cases which illustrate these features are the basis of this contribution.

Acute atrophy of the liver is characterized by marked diminution in the size of the liver which often becomes reduced 50 per cent in less than 2 weeks. The etiology is obscure. The disease occurs in apparently healthy individuals as well as in those who present some acute or chronic infection. The condition has been attributed to infection, to the action of some toxin or a combination of these two. Although nothing definite is known as to the character and source of the etiological factors it is significant that similar, if not identical, lesions have been noted after the administration of salvarsan.

The symptoms develop insidiously and consist for the most part in headache; digestive disturbances, as vomiting and epigastric discomfort; jaundice; moderate fever; and later delirium, convulsions, and coma. Many cases terminate fatally in a few weeks but some persist for months. We will not dwell upon the clinical features other than to state that they usually present a picture sufficiently definite to warrant a probable diagnosis.

In what percentage of cases leucin and tyrosin are present in the urine is not known, yet the question deserves consideration since it involves a factor which may prove of diagnostic importance.

Freichs is said to have first described the presence of leucin and tyrosin in the urine in cases of liver atrophy. He believed that their presence was due to the fact that the liver, on account of its damaged condition, could not transform into urea the leucin and tyrosin absorbed from the intestinal tract.

Jacoby, in 1900, found these bodies in a case of phosphorous poisoning. He proposed the theory that their presence is due to autolysis of liver cells. This theory has been generally accepted.

Leucin and tyrosin are obtained from extracts of pancreas, spleen, thymus, lymph glands, thyroid, salivary glands, kidneys and liver. They may be found in the urine in erysipelas, enteric fever, small pox, and in obscure febrile conditions as well as in acute

[1] Read before Southern Surgical Association, December 13, 1922.

and subacute yellow atrophy. In some cases of acute yellow atrophy they have been found in the liver but not in the urine. In the type of atrophy described in this paper, they were reported present in MacCallumn's case and absent in Cayley's. If one accepts Jacoby's theory of autolysis of liver cells, the presence of leucin and tyrocin in the urine may be dependent upon the stage of the liver lesion. If degeneration is active they might be present but if regeneration is active and degeneration partially arrested they might be absent.

Since the bacillus naphthaline sulphochloride method has been used in the detection of aminoacids these bodies have been found in normal urine.

The first significant pathological change consists in fatty disintegration of the liver cells, as a result of which the liver enlarges. Rapid absorption of the products of disintegration follows with diminution in the size of the liver. The destroyed areas present only connective tissue with large numbers of tubules like small biliary ducts. Localized areas of hyperplastic tissue develop, apparently representing a compensatory reproduction of the lost hepatic parenchyma. The appearance of the organ depends upon the stage of the disease. The hyperplastic changes are noted particularly in the prolonged cases and constitute a late feature.

The lesion under consideration is of interest to the surgeon chiefly because of the great uncertainty and embarrassment which results when it is encountered at operation and not identified. The writers have each had such an experience. The liver, however, presents so characteristic a picture that the true condition should be identified.

The liver is much reduced in size; the major portion of its surface appears about normal in color, smooth, and apparently not diseased; projecting from the surface are tumor-like bosses varying in size from about 1 to 4 centimeters. These nodular excrescences suggest neoplasms and might be mistaken quite readily for carcinomatous metastases. In one of our cases they were of a congested red or bluish color; in the other yellowish when seen at operation. The liver edge is extremely sharp and acute and when palpated between the fingers gives a leathery feel. For biopsy one instinctively removes a portion of one of the apparent new-growths. This is one of the features worthy of emphasis since the seemingly normal liver substance between the nodules and not the bosses show the characteristic lesion, and it is from this normal appearing tissue that a biopsy should be made. This tissue shows absence of liver cells, that is atrophy; the bosses present the picture of hyperplasia of liver tissue. Examination of tissue from one of them does not reveal the true lesion which can only be inferred unless the adjacent liver tissue is available for study. A second feature worthy of emphasis is the wide difference in the appearance of the same organ when seen *in vitro* on the operating table and at autopsy. This factor has not received the attention it deserves. Pathologists describe the bloodless organ, the surgeon sees the organ distended with circulatory blood. We are prone, then, to expect in such unusual cases the conditions described by pathologists on the basis of examination of bloodless autopsy specimens.

The condition of nodular hyperplasia has long been recognized and was accurately described years ago. Thus, in 1895, Marchand presented a full description of the pathological findings in such a case. Meder, at the same time, discussed the origin of the hyperplasia and concluded that it originates in the interlobular bile ducts. Little emphasis, however, seems to have been placed on the condition in recent writings.

Case 1. Woman, age 21, Russian, feathermaker, admitted December 6, 1915. Died March 30, 1916. Diagnosis: Acute (yellow) atrophy of the liver.

The patient was always strong and healthy. History negative up to 3 years before admission; since then she had "stomach trouble" which consisted chiefly in epigastric distress after eating, more especially after a heavy meal, and lasting an hour or two; not severe enough to keep her awake. Chronically constipated. Epigastric pain rarely occurred oftener than one day a week; sometimes no oftener than once a month. No vomiting. Very little nausea. No jaundice. Painful and swollen glands on left side of neck for one week, 6 months ago. Other details of history not important.

Present illness began about 2 weeks before admission with gradual yellowing of skin over body. Stomach trouble became more constant, with epigastric pain and burning, nausea, loss of appetite,

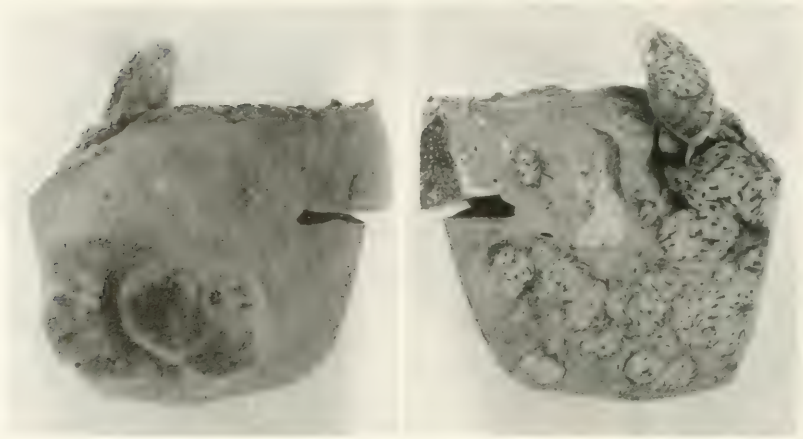

Fig. 1. Case 1. At left, gross specimen of liver; at right, cross section of same. Bosses appeared blue in color at operation; yellow at autopsy. Remainder of liver normal color but with knife-like edge.

and occasional vomiting after meals. No attacks of severe pain. Stools not observed. Severe headaches at times. Itching was severe in the second week. Nervousness and weakness since onset, but patient was able to continue working until 3 days before admission. No glandular swelling observed recently.

Physical examination on admission. Patient is a well-developed, well-nourished girl lying quietly in bed. She appears acutely ill, has no dyspnœa. The pupils are equal, regular in outline, and react normally to light and accommodation. No nystagmus, strabismus or ptosis present. Scleræ are slightly yellowish. The teeth are poorly kept; pyorrhœa present. The tongue protrudes in midline, is not tremulous nor coated. Tonsils are not enlarged nor inflamed. The pharynx is normal. The neck is not stiff nor tender. No venous engorgement or abnormal pulsations are present. The thyroid appears slightly enlarged. No tracheal tug present. On each side of neck but greater on left side, there is a swelling which on palpation proves to be several rather hard nodes. There are palpable nodes in axillæ, inguinal region, and popliteal space; the nodes, however, are not greatly enlarged. The abdomen is soft, with no tenderness, rigidity or masses. The liver edge is palpable 2 centimeters below the costal margin in the right mammillary line. The edge feels sharp and firm. No irregularities are felt. The gall bladder is not felt. The spleen edge is palpable 1 centimeter below the costal margin on deep breathing and feels firm. The kidneys are not palpable. Knee-jerks are present and equal. No pretibial œdema, scars, or thickening.

December 7, 1915, stools show no bile present.

December 15, 1915, stools show no bile, but much mucus.

January 2 to 10, 1916, coagulation time (6 tests) varied between 3 and 8 minutes.

December 8, 1915, serological examination of blood—Wassermann negative.

January 8, 1916, serological examination of spinal fluid—Wassermann negative.

	December 7, 1915	March 6, 1916
Blood count—		
White blood cells	6,800	21,000
Red blood cells	4,104,000	
	Per cent	Per cent
Hæmoglobin	80	
Polymorphonuclear neutrophiles	69	76
Polymorphonuclear basophiles	0	0
Polymorphonuclear eosinophiles	0	0
Large mononuclears	1	2
Small lymphocytes	30	21
Large lymphocytes		1

Urine examination was always about as follows: December 7, 1915, specific gravity, 1,023; acid; dark amber color; no turbidity or precipitate; faint trace albumin; no glucose. Microscopic examination showed many epithelial cells, no casts; bile +++; urobilin, +++.

Blood pressure average, 110 systolic, 70 diastolic.

For the first two weeks temperature ranged from 99 to 100. On December 24, temperature began to rise somewhat and about every third day was quite high; for instance, December 25, 103°; December 28, 102°; December 31, 104°.

Leucocytes at this time were 12,000, 66 per cent polymorphonuclears.

From January 5 to March 4, temperature ranged in general below 100°, with occasional slight rise above this. From March 4 to March 18 (date of abdominal operation), temperature became some-

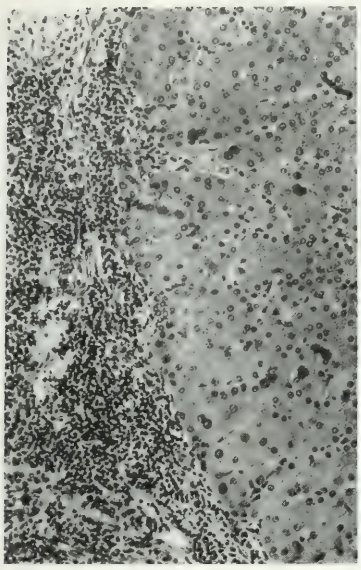

Fig. 2.

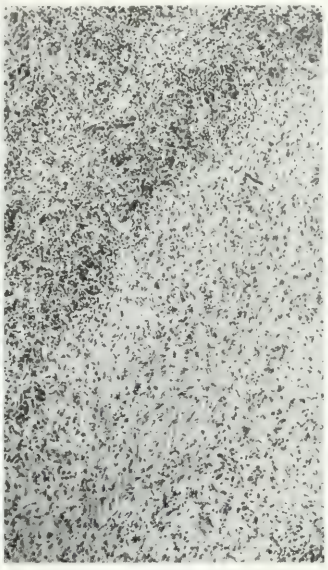

Fig. 3.

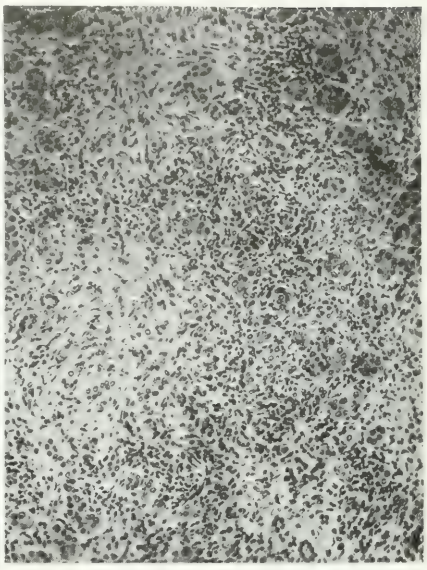

Fig. 4.

Fig. 2. Case 1. High power of border of area of nodular hyperplasia. Some liver cells showing double nuclei; marked round cell infiltration of adjacent liver tissue.

Fig. 3. Case 1. Atrophic liver. Structure of main mass of liver. Complete absence of liver cells. Section presents connective tissue (replacement fibrosis) with small round cell infiltration and some cell detritus.

Fig. 4. Case 1. Newly formed bile ducts and small round cell infiltration adjacent to area of nodular hyperplasia.

what more elevated, 102°–103° on several days, with leucocytes 20,000, 80 per cent polymorphonuclears.

January 3, 1916, supraclavicular nodes were removed for diagnosis.

Pathological diagnosis: endothelial hypoplasia of lymph nodes, no evidence of Hodgkin's disease or tuberculosis.

Aerobic and anaerobic cultures from macerated gland tissue were sterile, 7 days.

Operation. Exploratory laparotomy March 18, 1916. The gall bladder was found normal. The liver, very small and presented on all the accessible parts rounded projecting nodules about ½ inch in diameter, projecting about ¼ inch to ½ inch from the surface of the liver. These were dark blue in color. The surrounding liver was liver red. A piece of one of the projections was removed for microscopic examination, also a lymph node from the lesser curvature of the stomach. The peritoneal cavity contained about 2 quarts of thin, bloody fluid, which was removed with aspirator.

After operation the temperature remained under 100°, pulse around 92.

On the third day after operation, patient was restless, irrational, and involuntary. On the fifth day she vomited about 12 ounces of dark brown fluid. On the eleventh day she became comatose, pulse and respiration became rapid and weak; twenty-four hour specimen of urine, 17 ounces. March 29, 1916, patient was in coma all day; did not void, and was catheterized. Total urine, 12 ounces. Died. Partial autopsy showed nothing abnormal except in liver.

Pathological report as elaborated by Dr. Elser. After the operation the following material was sent to the laboratory for examination: bloody fluid from peritoneum which was cultured and proved to be sterile; two small lymph nodes from lesser curvature of stomach which showed no specific histological changes, and a small piece of tissue removed from a nodule in the liver. Microscopical examination of this material showed the microscopic features of a hyperplasia of liver cells. The lesions are regarded as compensatory in nature and strongly suggest the existence of destructive lesions elsewhere in the liver.

March 30, 1916. Autopsy specimen consisting of a portion of liver, several inches in diameter, removed after death through the laparotomy wound. The surface of the liver presents a slightly wrinkled appearance, is dark brownish red in color. The organ is leathery in consistence, and its edges are sharper than normal. Projecting from the surface for a distance of about 2 centimeters, there are two irregularly circular, rounded nodules which measure respectively 3.5 by 2.5 and 2.5 by 1.5 centimeters across, and are softer in consistence and lighter in color than the surrounding structures. On section the liver is found to contain numerous circumscribed nodules of a light greenish color. The intervening structures are dark brownish red in color and fail to show the usual lobulations of liver tissue.

Microscopic examination. Sections of the brownish red areas show the usual features of the late stages, the so-called atrophy stage, of acute yellow atrophy of the liver. The pictures presented by sections taken from different regions of these atrophic portions of the liver are not wholly identical but differ in accord with the varying degrees to which the process of repair and shrinkage has progressed in different parts of the organ. In general the sections show broad cellular bands representing the thickened and extended portions of the internal projections of Glisson's capsule and less cellular islands representing what remains of the original liver lobules. These latter regions show no cellular elements which can be identified as liver cells. They consist in the main of the original supporting structures of the liver lobules, variable amounts of débris representing the remnants of liver cells, extravasated blood, newly formed connective tissue, and blood capillaries. In addition considerable amounts of blood pigment and numerous fat granules are found scattered throughout these areas. As already indicated the differences in the size and appearance of these areas in different sections are determined by the extent to which replacement of necrotic material by young connective tissue has occurred, and the degree of shrinkage of this scar tissue which followed.

The broad bands referred to above are densely infiltrated with round cells of the lymphocyte type and are traversed by numerous channels lined with epithelial cells and having the appearance of small bile ducts. These are for the most part newly formed bile ducts and represent attempts at regeneration. Whether these regenerative efforts eventually lead to the formation of new liver lobules or remain abortive in nature is still a much disputed question. Apart from ducts which are readily identified as bile passages, there are numerous small collections of cells which approach in appearance liver cells but are considerably smaller than adult liver cells. Concerning the exact nature and origin of these collections of cells, there is considerable doubt. Some surround in an orderly manner minute canals which are filled with stagnated bile and are rendered visible because they are so distended. Other islands show no evidence of canalization, are not arranged in an orderly manner, and apart from their diminutive size suggest collections of liver cells. Whether these islands represent newly formed liver cells, and if so originate as the result of a budding process of bile ducts or from pre-existing liver cells cannot be determined without a more detailed study of serial sections. The presence of bile in some of these newly formed canals suggests that they do not communicate freely with the larger secretory ducts and may indicate that they are not at all connected with the biliary passages, but whatever the cause of the stagnation may be the presence of retained bile affords a satisfactory explanation of the obstructive nature of the jaundice in these cases.

Microscopic examination of the circumscribed nodules show them to consist of hyperplastic liver tissue. The lobules are somewhat deformed; the liver cells show irregularities in arrangement and in places evidences of unusually active proliferation approaching neoplastic proportions (marked irregularities in the size and staining peculiarities of the nuclei). Many of the liver cells contain bile pigment and in places the intralobular bile passages are plugged with bile, suggesting imperfect union with the extralobular bile ducts or partial obstruction or complete occlusion of the latter. The bile stasis indicated by the findings accounts in part for the jaundice observed in this case and also for the greenish tint of these areas noted above.

The connective-tissue stroma traversing these large islands of liver cells is infiltrated with round cells, but one misses the proliferating bile ducts which suggests that these islands originated from pre-existing liver cells.

Case 2. Mrs. A. A., age 64 years. April 9–15, 1922. Diagnosis: Acute yellow atrophy of the liver. Chief complaint: attacks of pain in right upper quadrant; nausea and weakness. Complete hysterectomy for fibroids was done in 1911. She has had gastro-intestinal disturbances for years with nausea. The bowels are constipated. For several years she has had nocturia four to five times per night. She has had occasional attacks of pain in right lumbar region, and moderate amount of pus in urine. Six months ago patient had a bad attack of influenza and did not regain her health, her chief complaint being loss of appetite and weakness.

For the past 4 months patient has suffered from indigestion, gas after eating, and asthenia. She becomes exhausted after walking about one city block. She has had several attacks of pain in the right upper quadrant associated with nausea but no vomiting until the present attack.

Present illness began about 2 weeks before admission with gradual yellowing of skin over body. Two days before admission she was seized with violent attacks of pain in the right upper quadrant radiating to the lumbar region; marked nausea and persistent vomiting.

Physical examination on admission shows a well-nourished, elderly woman, who is up and about. Pupils are equal and react to light and accommodation. Conjunctivæ are of good color. Teeth are in good shape; no pyorrhœa. Tonsils are negative. Pharynx is normal. No enlargement of thyroid present. Heart and lungs are negative. Abdomen shows no rigidity, and no masses are felt. There is distinct localized tenderness in the region of the gall-bladder. No muscle spasm is noted nor are masses. Spleen is not felt, kidneys not felt. Vaginal examination is negative. Knee jerks are present and equal. No pretibial œdema or thickening present.

Blood examination: coagulation time, 3 minutes; white blood cells, 9,000; polymorphonuclears, 58; small lymphocytes, 20; large mononuclears, 22.

Urine examination: Specific gravity, 1,012; reaction, alkaline; albumin, very faint trace; glucose, negative; bile, negative; white blood cells, few.

Fig. 5. Case 2. Gross specimen of liver. Marked atrophy of liver with raised bosses which represent areas of newly formed liver tissue (nodular hyperplasia).

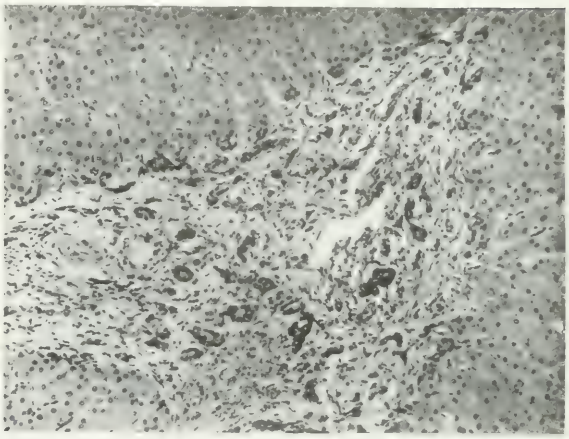

Fig. 6. Case 2. Area of nodular hyperplasia enclosing area of connective tissue containing numerous small bile ducts assumed to be newly formed.

Stools normal in color.

Wassermann, alcoholic and cholesterin, negative.

Five days after patient was admitted to the hospital, fluoroscopic examination suggested adhesions about gall-bladder and duodenum. While in the hospital the patient became definitely jaundiced.

April 15, 1922, the patient went home.

May 2, 1922, readmitted to hospital. She was worse for few days after returning home but has improved slightly during the last week. Jaundice is less than during her last admission. She has had colon irrigations q. d. but has remained obstinately constipated, constant nausea, and has had numerous fainting attacks with pronounced weakness.

May 3, 1922, operation. Upon opening the peritoneal cavity several ounces of turbid bloody fluid escaped. Liver was found to be much smaller than normal with numerous irregular, raised areas, which were yellowish gray in color and elevated about 1 to 2 centimeters above surface of the liver. Other areas of the liver were red in color but the edge was knife-like on palpation. Gall-bladder was thickened and emptied with some difficulty. There were numerous inflammatory adhesions between the gall bladder, pylorus, and stomach. These were freed. The common duct appeared about normal in size, but there was considerable œdema of the tissues about it, and there were several enlarged lymph nodes. Gall-bladder was removed. Rubber dam was inserted to the cystic duct and the wound closed in layers.

Pathological report May 6, 1922. Specimen consists of a gall bladder apparently unchanged in the gross.

Microscopical examination. The section shows a definite polymorphonuclear and round-cell interstitial infiltration of the wall.

Patient did well for three days after operation when she became drowsy and finally could not be aroused. There was rather profuse serous oozing from the wound. Reflexes were exaggerated. The abdomen was slightly distended but bowels and urine were involuntary. Temperature 100°, pulse, about 90.

Autopsy report by Dr. Elser. The description of the liver only will be given here. Diagnosis: yellow atrophy of liver; late stage with compensatory nodular focal hyperplasia.

The liver is much reduced in size. It measures approximately 15 by 20 by 6 centimeters and weighs 600 grams. The most striking feature of the organ is the presence on the surface of tumor-like projections which vary in size and form. Some are slightly raised plateau-like elevations made of closely aggregated, irregularly circular, flat projections separated by narrow, shallow depressions. These areas project about ½ centimeter above the neighboring structure. Others present a smooth, rounded surface, project from 1 to 2.5 centimeters above the surface of the organ and are irregularly circular in outline. The largest nodule of this type is situated on the upper surface of the organ just to the right of the falciform ligament. It occupies an area about the size of a silver dollar and projects above the surface for a distance of 2.5 centimeters. These nodules are bright greenish yellow in color, and in appearance suggest a glandular structure. The intervening portions of the liver present a pale grayish pink, finely granular appearance. The capsule of the liver is normal in thickness and presents a smooth surface. While the tumor-like portions are soft and friable, the remaining portions of the liver are tough and leathery in consistence. The shape of the organ apart from the irregularities produced by the projecting masses is not much altered. It presents a knife-like anterior border which measures 1 centimeter from the free margin not more than 0.5 centimeter in thickness. On section the nodules referred

to above are bright greenish yellow in color. The nodules present irregular but well-defined borders. The remainder of the cut surface of the organ is grayish pink in color with a few dark hæmorrhagic areas and the normal markings are completely obliterated. These latter areas show no definite evidences of icterus.

The picture presented is at first sight that of a neoplasm of the liver. The extreme atrophy of the organ (which could be recognized even when only a small portion of the anterior border is visible, by the marked alteration of the anterior edge) would guard against the diagnosis of a genuine new-growth of the liver.

The diagnosis at autopsy presents no difficulties. The tumefactions represent the hyperplastic remains of relatively normal liver tissue while the remainder of the organ shows the most advanced terminal stages of a process of necrosis and complete disappearance of liver cells with partial replacement by fibrous structures. These are the portions which should be selected for excision of tissue to be submitted to the pathologist for diagnosis. Tissues removed from the tumor-like areas will not enable the pathologist to make a diagnosis as to the exact nature of the disease.

Aerobic and anaerobic cultures from liver, spleen, and blood of guinea pig injected with 1.2 cubic centimeters of ground liver emulsion show growth of bacillus coli communis.

Microscopic examination of the liver shows practically the same lesions noted in connection with the preceding case. While there are minor differences such as more marked proliferation of bile ducts in the stroma of the hyperplastic portions of the organ, and fewer islands of cells resembling liver cells in the atrophic areas, these are merely quantitative differences.

CONCLUSIONS

The clinical picture in a case of acute atrophy of the liver, especially of the subacute type, should suggest the correct diagnosis. Careful examination should be made to ascertain the size of the liver. A small liver or progressive diminution in the size of the liver should confirm the diagnosis. Whether significance should be attached to the presence or absence of leucin and tyrosin is uncertain.

The operative findings of acute yellow atrophy with nodular hyperplasia are characteristic and should be identified at once. The liver is small with sharp, knife-like edge; the surface presents circumscribed elevated nodules. These represent hyperplastic liver tissue and may present a hyperæmic appearance or a yellow tint.

A section of one of the nodules does not show the characteristic lesion; therefore biopsy should include liver tissue independent of the nodule since this tissue shows the characteristic atrophy of the lesion.

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ABERRANT GASTRIC MUCOSA

Report of Two Cases—An Umbilical Polyp and a Meckel's Diverticulum[1]

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THE occurrence of gastric mucosa elsewhere than in the stomach is unusual; however, masses of cells typical of this tissue have been found at the umbilicus, in Meckel's diverticula, and in fistulous tracts which open at the umbilicus. We have been able to find 17 such cases reported in the literature. The rarity of the condition, therefore, lends sufficient importance to two recently observed cases to justify reporting them. The chief interest lies in the nature and origin of such anomalies. It is for a discussion of these problems that this paper is presented.

These problems are best approached by studying the normal development of the intestinal tract. The embryologists (23) point out that the alimentary canal develops from the splanchnopleura, which results from the fusion of the entoderm and the inner layer of the split mesoderm. Therefore, the entire alimentary tract is made up of similar cells before differentiation takes place. One of the earliest evaginations of this tube is the yolk sac and its stalk ("vitelline" or "omphalomesenteric" ducts). Its point of origin in the gut tract is used as a convenient point to divide arbitrarily the canal into the "fore" and "hind" segments. This is especially suitable, as it serves as an attachment of the gut to the ventral abdominal wall and is the pivot around which the intestines rotate in their later development (28). In the human embryo the yolk stalk and sac degenerate early (5 to 9 millimeter embryo), its function being taken by the allantois. But the ducts remain for some time longer as a fibrous strand running in the umbilical cord and from the cœliac side of the umbilicus to the intestines. Up to the 17 millimeter embryo, that part of the intestines which the vitelline duct enters lies partially in the umbilical cord. Under unexplained pathological conditions the obliteration of the yolk stalk may not be completed, so that collections of cells or groups of cells or cysts may mark the embryonic position of the duct.

A survey of the literature presents 42 such anomalies, 17 bearing gastric mucosa and the balance presenting the usual intestinal mucosa. We have not considered the innumerable instances of persistence of the proximal end of the vitelline duct (Meckel's diverticulum), and have excluded also those cases which were reported without accurate histological descriptions. The two cases following make a total of 44 cases available for study.

Case 1. Umbilical polyp. N. W., male, age 18, fisherman. The patient entered Dr. Grenfell's Mission Hospital at Battle Harbor on the Labrador during the summer of 1917, complaining of a tumor at the umbilicus.

The family had noted a cherry-like tumor at the umbilicus as soon as the cord dropped off. In childhood the major part of the mass had been clipped off by an itinerant doctor, but it soon grew out to its present size. The tumor had given no pain or discomfort other than that attendant on the constant soiling of the patient's clothes. The polyp had never bled or ulcerated. There had never been a discharge resembling urine or intestinal contents, although a clear fluid constantly exuded from its surface. The skin around the base of the mass had never been eczematous or ulcerated.

The patient had lost his right eye through an abscess in infancy. He had had no other illness except that during the winter of 1916 he had been one of the few survivors of an epidemic of measles which ravaged the coast. The family history is interesting in relation to a sister who had been treated in the same hospital 3 years previously. During the course of a laparotomy it had been discovered that she had a uterus unicornis and that only the left tube and ovary were present.

Physical examination. The patient was well developed and nourished. The examination was entirely negative except for the disorganized right eye and the umbilical polyp. The navicular fossa was completely filled with the protuberant mass and its border was slightly elevated so that the tumor seemed to rise from a low pedestal. The mass was 3.5 centimeters long and 1.6 centimeters in diameter at its widest part, which was near the pendulous tip (Figs. 1 and 2). There was a certain de-

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Figs. 1 and 2. Side and front views of Case 1, showing the umbilical polyp.

gree of pedunculation as the base was only 1.3 centimeters in diameters. The tumor was acutely flexed at its origin so that the inferior aspect lay against the abdominal wall. The surface of the tumor was covered by a brilliant crimson mucous membrane to which a glairy discharge gave a shimmering, refractive polish. No sinus could be discovered, the secretion apparently exuding from the entire surface of the growth. The amount was so small that no collection was possible; therefore, no cytological examination could be made. The odor was neither uriniferous nor fæcal. Despite the appearance of softness the tumor was very firm and its base was strongly embedded in the abdominal wall.

Operation. Three days after admission Dr. C. Samuel Curtis, in charge of the station, removed the tumor and a zone of surrounding skin by an elliptical incision. No connection was found with the bladder, intestines or liver. It was not ascertained whether or not a Meckel's diverticulum was present. Cross sections of the tumor showed a thick fibrous core covered by a thin, soft, outer layer—the mucous membrane.

Histology. The microscopic sections were stained with methylene blue and eosin. At the periphery there was a large number of secreting glands, some cut in cross section, a few longitudinally. These latter were in many cases definitely branching glands of the gastric type, showing characteristic crypt, neck and tubules (Fig. 3). With lenses of higher power it was seen that the majority of the cells lining the glands were cuboidal with basally placed nuclei and granular protoplasm. These were the only cells to be found in that part of the gland considered to be the crypt. The tubules, however, showed another type of cell. This cell was irregular, but for the most part triangular in shape. It was peripheral in position and took the acid stain. These cells were undoubtedly identical respectively with the chief and parietal cells found in the fundus of the stomach (Fig. 4).

The fibrous core of the tumor, when microscopically studied, was found to be made up of connective tissue, blood vessels, and smooth muscle fibers. Throughout this tissue, as in the mucous membrane, there were mononuclear and polymorphonuclear leucocytes, the former predominating. There was no enveloping epithelium as the glands opened on the surface of the polyp, which was covered by a homogeneous mass, probably desquamated cells and the product of the glands.

Case 2. Meckel's diverticulum. N. W., male, age 18 months, entered the Children's Hospital, Boston, June, 1915, because of pain, tumor, and pallor.

History. The family and past histories were irrelevant. No symptoms had been noted previous to the day the patient was admitted. That morning the boy had been fretful, and early in the afternoon he vomited once. Later in the afternoon when the diaper was changed, fresh blood was found unmixed with the fæces. A few minutes later the child cried out and seemed to have a sharp pain in the abdomen. He rapidly became prostrate, fell asleep and remained asleep until seen by the physician.

Physical examination. The patient was well developed and nourished. The only abnormalities to be found during a complete physical examination were marked pallor and a small movable mass about 1.5 centimeters to the left of the umbilicus. The rectal examination was negative.

Operation. The patient was immediately brought to the Children's Hospital, Boston, and the abdomen opened by a midline incision. The operator found the rectum, colon, and part of the ileum colored as though filled with blood. The ileum was followed up to a point where the character of its contents obviously changed. This corresponded to the site of a diverticulum 5 centimeters long and 2 centimeters in diameter. It was at the point where Meckel's diverticula occur. The walls of the diverticulum were œdematous, as it had been inverted, much as a glove finger may be pushed in. The diverticulum was excised and the patient made an uneventful recovery.

Histology. The incised diverticulum showed at its invaginated tip a thickened mucosa. On microscopic examination it was found that the glands in this section did not resemble the normal intestinal glands which lined the major part of the diverticulum. The sections were stained with methylene blue and eosin. The glands were mostly cut in cross section, but some of those cut longitudinally showed that the glands branched in a way typical of those of the mucosa of the gastric fundus. The most striking feature of the picture under the higher power of the microscope was cells staining a brilliant red. They were triangular in shape and were placed at the periphery of the gland. The nuclei were round and central in position. The more numerous cells were identical in staining qualities, morphology, and position with the "chief cells" described in the preceding case. In short, the tissue was identical with gastric mucosa (Figs. 5 and 6).

That the so-called Meckel's diverticulum is in reality a portion of an incompletely

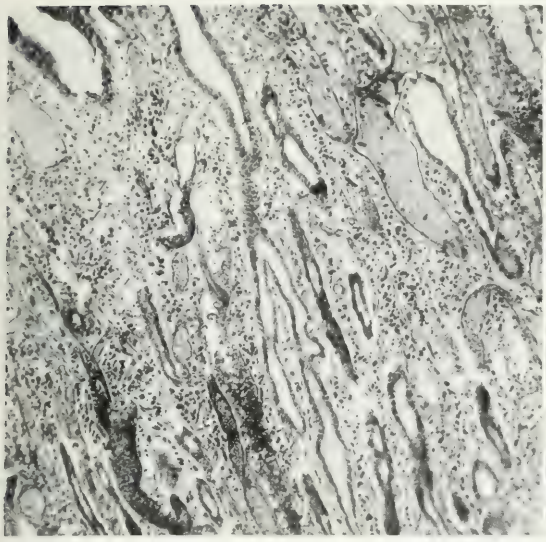


Fig. 3. Photomicrographs showing definitely branching glands of gastric type, with characteristic crypt, neck, and tubules.

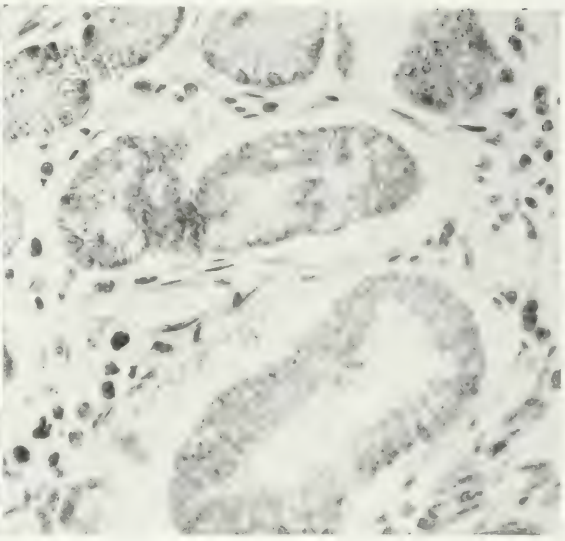
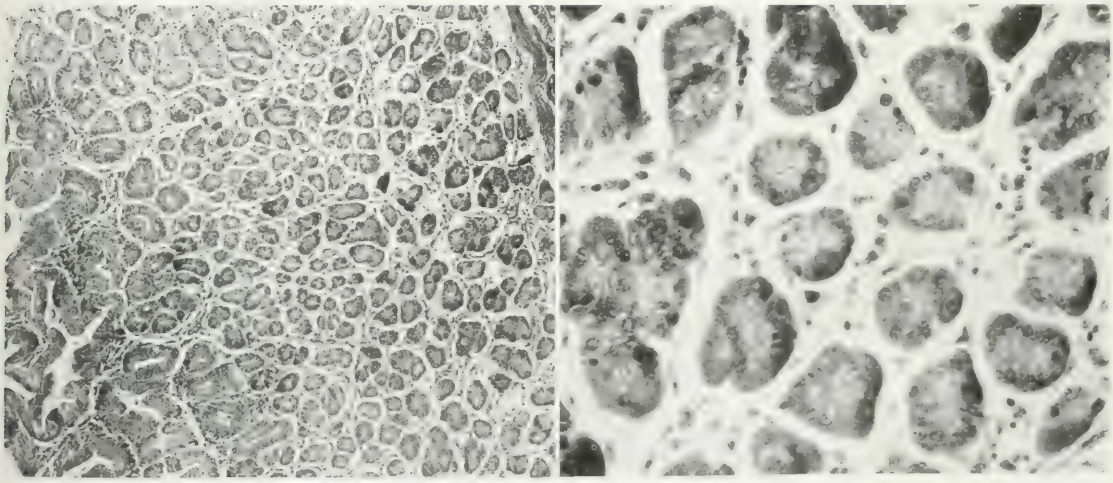


Fig. 4. High power photomicrograph showing that the majority of the cells lining the glands were cuboidal with basally placed nuclei and glandular protoplasm.

obliterated vitelline duct has long been accepted as proven. But it is less clear that some polyps at the umbilicus, which have no internal attachment, are remains of the same structure. However, there are intermediate cases which bear on this point. The discussion of the subject will be approached through this type of case.

Salzer (26) in 1904 reported a case of fistula at the umbilicus. From it came a watery discharge with a fæcal odor. It was found that the tract ran as a tube, in diameter the size of a Meckel's diverticulum, from the umbilicus to a point on the ileum at which these diverticula usually enter it, i.e., about 8 centimeters proximal to the ileocæcal valve. If the obliteration of the duct had occurred inside the abdominal wall instead of at the surface only a Meckel's diverticulum would have been found. The mucous membrane



Figs. 5 and 6. Low and high power photomicrographs, Case 2, showing cells of identically the same character as those in Case 1.

lining the tract was identical to that of the normal gastric fundus. W. H. Battle (2), C. Green (10), and Holmes (14) each report a similar case, except that in these the lining membrane was intestinal.

Denucé (6) and Lexer (20) each report a case in which a sinus discharged persistently at the umbilicus. In both cases a Meckel's diverticulum was found attached to the umbilicus by a fibrous cord, in which no lumen existed except at the skin surface. The tissue at the umbilicus was gastric mucosa. Barron (1) has recorded a case akin to these in which no lesion was found on the surface at the umbilicus; but buried deep in the abdominal wall at the umbilicus was a cyst containing gastric mucosa and continuous with the stroma around the cyst was a Meckel's diverticulum.

It is no stretch of the imagination to conceive that if the process of obliteration in the above cases had continued inside the abdomen to such an extent that even the fibrous cord or the Meckel's diverticulum had disappeared, the lesions at the umbilicus might have persisted. In this event a lesion would have resulted similar to the majority of the cases reported in the literature, where only the abnormality at the abdominal wall was found. In view of the preceding transitional cases, it is evident that these fragments of tissue are remnants of the omphalomesenteric ducts, all other portions of which have disappeared. Some 20 cases of such umbilical tumors, covered with intestinal mucosa, have been recorded. There also have been reported 4 cases similar to these, except that they had gastric mucosa on their surface.

The cases in the first group vary but little from one another. Barron (1) reports the case of a five-year-old girl who had suffered from a raised raw surface at the umbilicus from the time the cord dropped. The polyp, 5 millimeters by 9 millimeters, looked like exuberant granulation tissue; but on section showed a central core of smooth muscle and connective tissue surrounded by a zone of glands similar to intestinal mucosa. Colman (4) reported an exactly similar case in a child 2 months old, the lesion being discovered at the separation of the cord. Fox and MacLoed (7) observed in a man of 65 an eczematous patch at the umbilicus 5 centimeters in diameter, which had been forming for 11 years. The raw center passed peripherally into a circular ring of raised, brawny tissue. The sections showed modified intestinal mucosa with many degenerative cells of many types. There were practically no leucocytes, and the apparently inflamed area was made up of plasma cells. Hektoen (11) demonstrated intestinal mucosa in a small polyp at the umbilicus, which was first noted 15 years after the birth of the patient. As in most of these cases, the tubules opened on the surface of the tumor. Von Heukelom (12) reports in detail the case of an umbilical polyp 1.5 centimeters by 2 centimeters in 2½-year-old child. The outer 2 millimeters of the tumor was made up of typical intestinal mucosa. He cites twelve other cases somewhat similar to this, but fails to note the type of mucous membrane present. Hollandersky (13) presents the case of a 3-year-old boy with a pedunculated umbilical tumor, the covering of which was a mucous membrane containing Brunner's and Lieberkuhn's glands. In 1868 Holmes (14) had a patient with an umbilical tumor of intestinal origin. Holt (15) also reported a case similar to this, while Hue (16) reports five. Kirmisson (18 and 13) adds two more. Kolaczek found two in his private practice. Lunnenlonguet and Fremont (22) present three other identical cases, Lowenstein (21) adds another and Tarbox (27) completes the list with the report of a case in a girl of 12.

The cases in the second group are similar to the preceding, except that their mucous membrane is identical to gastric mucosa. In 1880 Pearce Gould (9) presented at a clinical meeting a 5-months-old infant with a pedunculated tumor springing from the cicatrix of the umbilicus. The surface of the mass was gastric mucosa, which also extended into the tumor as branched glands with a single layer of columnar epithelium. A. von Rosthorn (25) in 1889 reported the case of a 7-year-old boy who suffered from a fistula which opened on the surface of an umbilical polyp. The tract admitted a probe 2 centimeters. The passage discharged 5 cubic centimeters of fluid in 2 hours. The fluid

had an acid reaction and slowly digested albumin. Branched glands were found in the depths of the mass. They opened on the fistulous tract. Another boy 18 months old was treated by W. Roser (24) for the relief of a tumor at the umbilicus, at the tip of which a cavity 1 centimeter in diameter opened through a small duct. The secretion was similar to that in the previous case, as was the mucosa lining the cavity. Tillman (29) in 1882 had a boy of 13 years who had suffered from a pedunculated tumor the size of a walnut, which was seen as soon as the cord sloughed. After meals the tumor increased in size and in 14 minutes secreted 2 to 3 cubic centimeters of clear fluid. Chemical analysis of the secretion showed it to be identical to the gastric juice, and histological examination of the mass confirmed the analysis.

These interesting remnants present several problems, which in the present state of our knowledge are not completely answerable. What determines the persistence in some cases? How is it that the cell type in 18 of the cases should be gastric rather than intestinal? Again, why is it that in 57 per cent of the cases the glands open on the surface when they originally lined a tube?

The last of these problems is more amenable to approach than the others, and so may be attacked first. Macroscopic and microscopic examination of colostomy openings first suggested a tenable theory. During the first weeks following operation the mucous membrane of the intestine, which was at the level of the skin, prolapses and everts in all directions so that it forms a flange around the incision and projects above the level of the skin. The flange has a covering of intestinal cells, the most distal of which face outward, and as they gradually follow the arc of the pouting surface, face inward as the lumen forms to dip into the abdomen. Now, where the lumen giving rise to the everting mucous membrane is as small as in the cases of umbilical polyp, it is entirely possible that time and pressure obliterate the cells that still face each other in the uneverted lumen, and that their place be taken by the core of fibrous tissue so often present in these tumors. Even if the remnant appeared originally as a cyst in the abdominal wall, the secretion might lead to its rupture on to the skin, and the same process as described above could readily follow. So it may be suggested that the glands open on the surface as the result of a process of evagination and central necrosis and fibrosis of the cells lining the original lumen of the omphalomesenteric duct.

It is curious that the glands which open on these tumors so frequently contain gastric elements. However, the knowledge that the cells of the intestinal tract have a common origin makes their appearance understandable even if the processes by which the aberrant differentiation occurs is not known. The embryologists have long ago exploded Tillman's (29) theory that the gastric mucosa was the result of a gastric diverticulum pinched off in the umbilicus, by showing that from extremely early fetal life the liver is interposed between the stomach and the ventral wall of the abdomen. Von Heukelom (12) laid stress on the fact that in many cases where gastric mucosa is present the part which undergoes the abnormal differentiation is shut off from the gut tract very early. From this he concludes that the presence of the meconium and bile determines the characteristic cytology of the intestines, and that where they were absent the gastric type of cell developed. In refutation of this it may be pointed out that fetuses swallow their meconium and that as shown by Wislocki (30), bile is found in the stomach of chicks on the tenth day of incubation, without inhibiting the development of the gastric glands. Bensley (3), as a result of a comparative study of the cardiac glands of mammals, has suggested that their specialization is due to the mechanical effect of the food in its several phases passing through the stomach. But this does not seem applicable to a stomach which has fluid content until long after differentiation is complete.

In previous discussions a factor has been omitted which may have some bearing on the subject, although its importance is not susceptible to proof. The parts of the intestines which undergo slow quantitative growth show none of these abnormalities. The part

which develops most rapidly is the small intestine. It may be that rapid proliferation may inhibit the high degree of differentiation found in gastric or pancreatic mucosa. It is just that part of the foregut which undergoes the slowest growth, the stomach, that gastric mucosa lines. And it is at the other fixed end of the fore gut, i.e., at the site of the junction of the vitelline duct with the intestine, where growth is also comparatively slow, that high specialization is met with if a part of the duct persists. So it is at least permissible to suggest that rapidity of growth may determine the development of intestinal glands as found in the ileum, and sluggish quantitative growth may permit higher specialization.

That abnormalities are prone to occur where processes of development profoundly alter early embryonic conditions is a truism. Hence it is no more surprising to find pathological changes where a cord containing ducts, blood vessels, and stroma must be completely obliterated than to find meningoceles where the central furrow does not unite perfectly in its dorsal folding, or cystic kidneys where the two parts of the kidney meet imperfectly. But to explain why the abnormality under discussion occurs in some rather than in other persons is as difficult as in the cases of the other instances of faulty development just cited. Several prenatal conditions leading to abnormalities at the unbilicus may be suggested, but cannot properly be demonstrated until our means of studying intra-uterine life are further advanced. Traction on the cord may inhibit obliteration of the duct by stimulating continuous cell proliferation. Abnormalities of intra-uterine nutrition could conceivably produce such biological changes by reducing the energy of the fetus. These are but poor guesses, and in short this phase of the subject remains buried in the pall of ignorance that for ages has surrounded it.

CONCLUSIONS

1. Umbilical polypi bearing cells which could have developed from the splanchnopleura are remnants of the vitelline ducts.

2. The mucous membrane on the surface of these tumors may be the result of a process of evagination, central necrosis, and subsequent fibrosis of a tubular element.

3. The original cells lining the vitelline duct have the power of differentiating into any type of cell that the foregut is capable of normally developing.

4. The actual factors producing the abnormal stimulation, or lack of stimulation, for the obliteration of the vitelline duct are unknown.

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PLACENTAL IRON AND ITS RELATIONSHIP TO ICTERUS NEONATORUM[1]

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THE incidence of jaundice in the newborn varies from 50 per cent in some clinics to 80 per cent in others. The reasons for its occurrence are varied and the question is far from being satisfactorily explained. Von Reuss (1) lists the majority of the usual theories, and to them there have been recently added three others, namely: asphyxia at the expulsive stage causing the child to inspire a certain amount of mixed vaginal secretion and amniotic fluid with the jaundice resulting from the ingestion of this infectious material (2); Deluca (3), finding in a series of five hundred and fifty-four autopsies thirty-six with meningeal hæmorrhage, believes that the icterus is due to the blood pigment from this disintegrating hæmorrhage; Luska (4) considers the jaundice due to bacteriotoxic hæmolysis, because in his cases he recovered definite organisms and found that the antistaphytoxic titer was increased.

We were especially interested in the theory that the jaundice is due to hæmolysis of fetal or maternal blood in the placenta with the pigments transmitted to the fetus, while we believe the fetal liver plays a secondary and minor rôle. If the contention be true that the maternal blood is hæmolyzed and the pigment transmitted through the placenta and if it be true that there is a destruction of fetal blood and a consequent freeing of pigment, one should be able to find an excess of iron deposited somewhere and the amount of iron deposited should correspond quite definitely to the clinical extent of the jaundice. The figures presented in this paper seem to substantiate and demonstrate that the foregoing contention is probably true. Subsequent discussion in the paper will explain how by exclusion we determined the placenta as the storage place of surplus iron.

Method of determining the iron content of placentas. The placentas, as soon as born, were perfused with water under moderate pressure through the vessels of the cord, in an attempt to get rid of as much blood as possible from the gross placental circulation. The cord and the adherent tissue was cut away and the placentas were ground up in a meat chopper. The placentas which could not be ground up as soon as delivered were kept in an icebox. The ground tissue was placed in a filter cloth and washed in running water with constant squeezing until water passing through was almost clear. This was done in order to remove all hæmoglobin. At the beginning a benzidine test for hæmoglobin was used and it was found that in most cases 20 minutes' washing was sufficient to remove practically all hæmoglobin, despite which placentas were washed 30 minutes after the benzidine test was negative.

The washed tissue in a porcelain dish was next placed in a drying oven, kept at a temperature of 100° to 105° C. for 24 hours. By this time a constant weight was obtained and the tissue was thoroughly dried.

The dried material was again ground to a fine powder and weighed to the third decimal place. (It was necessary to use a large porcelain dish at this stage for on heating in the furnace again the tissue swells and some would be lost over the sides if a small container were employed.) Five cubic centimeters of concentrated sulphuric acid with enough water to cover the tissue was added and the tissue placed in a furnace and kept there for 3 to 5 hours until a clear ash was left. The heating was carried out gradually, at a low temperature for the first hour and then slowly raised. If too great heat is applied at first the material will suddenly fuse with the container.

The cooled ash was dissolved in 25 cubic centimeters of 10 per cent hydrochloric acid and then made up to a volume of 200 cubic centimeters in a volumetric flask, an aliquot portion of this being used for the iron determinations.

[1]From the Department of Obstetrics

A colorimetric method for iron content was employed, advantage being taken of the blue color given by iron with potassium ferro-cyanide.

The standard solution was made up from pure iron wire especially prepared for quantitative analysis. The standard solution was made up to contain 0.6656 milligrams of iron per 100 cubic centimeters of solution. A 10 per cent solution of potassium ferro-cyanide was added in slight excess to develop the maximum color and the colors matched in a Duboscq colorimeter.

Twenty-five cubic centimeters of the unknown iron solution were used. After the addition of the potassium ferro-cyanide when the color was developed, enough water was added to bring the intensity of the color approximately to the standard, the final dilution being noted and accounted for in the ultimate calculation.

The following formula was used for calculating results:

$$\frac{\text{Weight of dry tissue}}{\text{200 c.cm. (dilution of ash)}} \times \frac{\text{25 c. cm. (used for analysis)}}{\text{Final dilution (to color match)}} = A$$

$$\frac{\text{Reading of standard}}{\text{Reading of unknown}} \times 0.6656 = B$$

$$\frac{\text{B (milligrams of iron in 1 c.cm.)}}{\text{A (grams of placenta in 1 c.cm.)}} = \text{Milligrams of iron in one hundred grams of dry placenta.}$$

Clinical findings. The jaundice was merely observed clinically by the discoloration of the skin and such a procedure is open to criticism on the ground that in an open clinic such as one would find in a dispensary, considerable error could enter as a result of many nationalities with their own peculiar skin colorings and idiosyncrasies and also that milder cases of icterus might together escape attention. The blood determinations were made every other day and the time of taking the blood was approximately the same. The blood for counting was taken from the great toe, and there is a variation between this peripheral blood and longitudinal sinus blood due to volume, temperature, rate of flow, oxygenation and such factors. Hæmoglobin was determined according to the method of Sahli. The platelets were counted at once so as to be fresh, in a 10 per cent sodium citrate solution. The weight curves were taken directly from the clinical charts. The time of appearance and disappearance of icterus was noted as it became apparent in the skin and whenever there was a question as to whether icterus was present or not, the case was omitted from the series in an attempt to be grossly accurate clinically.

TABLE I

Case No.	Para	Sex	Jaundice Days	Term	Labor Type	Placental Iron, Mgs.
1	2	M	2–12	Yes	Spontaneous	44.93
2	3	F	None	Yes	Spontaneous	26.45
3	1	F	4–11	Yes	Difficult	34.08
4	1	M	4–10	Yes	Spontaneous	30.68
5	4	M	3–12	Yes	Spontaneous	32.09
6	1	M	None	Yes	Difficult	23.08
7	5	M	2–13	Yes	Spontaneous	33.36
8	2	M	None	Yes	Spontaneous	26.57
9	3	F	2–12	Yes	Difficult	36.92
10	1	M	2–16	Prem.	Difficult	46.17
11	2	M	3–13	Yes	Spontaneous	35.84
12	7	M	None	Yes	Spontaneous	20.50
13	1	F	None	Yes	Difficult	23.86
14	1	M	None	Yes	Difficult	19.80
15	1	F	None	Yes	Spontaneous	24.86
16	2	M	None	Yes	Spontaneous	21.26
17	1	M	2–15	Yes	Difficult	40.68
18	3	F	2–12	Yes	Spontaneous	39.13
19[1]	1	F	2–5	Yes	Spontaneous	35.79
20	7	M	None	Yes	Spontaneous	20.00
21	3	M	3–11	Yes	Spontaneous	32.34
22	2	M	None	Yes	Spontaneous	23.52
23	3	F	3–14	Yes	Spontaneous	37.16
24	2	F	None	Yes	Spontaneous	19.16
25[2]	8	M	None	Yes	Spontaneous	20.62
26	1	M	3–14	Yes	Difficult	36.93
27	3	F	3–11	Yes	Spontaneous	32.93
28	4	M	3–9	Yes	Spontaneous	28.11
29	2	F	None	Yes	Spontaneous	19.92
30	2	M	None	Yes	Spontaneous	24.78
31	3	F	3–13	Yes	Spontaneous	35.39
32[3]	4	M	None	Yes	Spontaneous	21.46
33	2	M	3–12	Yes	Spontaneous	31.82
34	1	M	None	Yes	Difficult	18.61
35	4	M	None	Yes	Spontaneous	23.90
36	2	M	2–16	Prem.	Spontaneous	47.59
37	3	F	None	Yes	Spontaneous	27.26
38	2	M	2–16	Yes	Difficult	44.85
39	4	M	3–9	Yes	Spontaneous	34.08
40	5	M	None	Yes	Spontaneous	23.21
41	1	M	None	Yes	Difficult	24.10

[1] Died—cerebral hæmorrhage.
[2] Twins—one placenta.
[3] Congenital intestinal obstruction.

From Table I it will at once be seen that the parity of the patient has no definite relationship to the jaundice nor to iron content. Fourteen males out of twenty-eight were icteric while five out of the remaining eleven females were jaundiced, so that no definite connection can be discovered so far as sex is concerned.

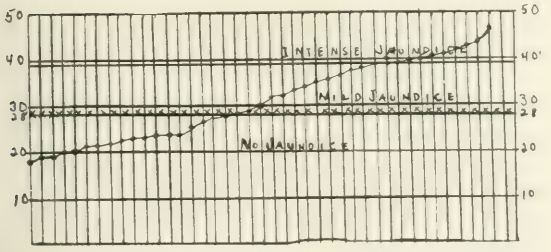

Chart 1. Each dot represents a case. Placental iron in milligrams per 100 grams dried tissue.

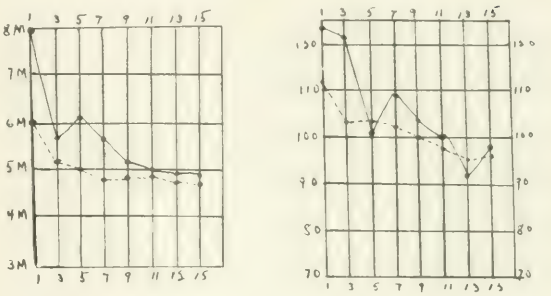

Chart 2. At left, red blood cell curve. Age of infants in days. Continuous line, non-jaundiced cases; interrupted line, jaundiced cases. At right, hæmoglobin curve. Age of infants in days. Continuous line, non-jaundiced cases; interrupted line, jaundiced cases.

The average time of the appearance of discoloration of the skin was from late in the second day until the eleventh day, while two cases persisted until the sixteenth day. Cases 10 and 36 were premature births at 7½ months, and these both had high iron content in the placenta, but it is to be observed that Cases 1, 17, and 38 were at term and they also had a high iron content. The majority of patients had easy deliveries, but Cases 26 and 41 had difficult labors, so that, if the question of asphyxia should enter actively as a factor in producing hæmolysis, we should expect to find both patients icteric, when, as a matter of fact, only one of the two was. Case 19 was a "bleeder" and cerebral symptoms were pronounced 24 hours after birth, and this is the only case that might come under the cause as given in a previous reference (3). Temperature above normal occurred in Cases 1, 7, 15, 18, 22, 27, 30, and 31, but not all these patients were consistently jaundiced. All the infants but Cases 7 and 12 were breast-fed and the evidence is not sufficient for the icterus to be attributed to artificial feeding.

Chart 1 shows graphically the apparent relationship between icterus and the placental iron content. All patients showed jaundice when the placental content was 28 milligrams and over, with a definite intensity when the content was above 31 milligrams.

Blood count. Our blood counts of red cells, white cells, and platelets correspond generally with the figures usually given for the early period of life. We were unable to detect any striking difference in count although the curve of red cells in the jaundiced cases was consistently lower than in the non-jaundiced cases, an observation noted by many others.

The hæmoglobin curves in the two groups are quite similar except that the curve in the jaundiced cases was a trifle lower throughout. The curves shown in Chart 2 graphically illustrate this matter.

Influence of weight. The following weight chart is interesting because it shows that the curve for jaundiced and non-jaundiced children is practically identical. It is a more or less accepted assertion that premature children are consistently jaundiced and also that their livers contain relatively more iron than full-term children. This series is far too small to draw any conclusion so far as weight is concerned (Chart 3).

From the tables and figures presented we are faced with two observations; namely, that certain children are jaundiced and their respective placentas contain a certain amount of iron, while beneath this amount of iron no jaundice appears, and that weight and tem-

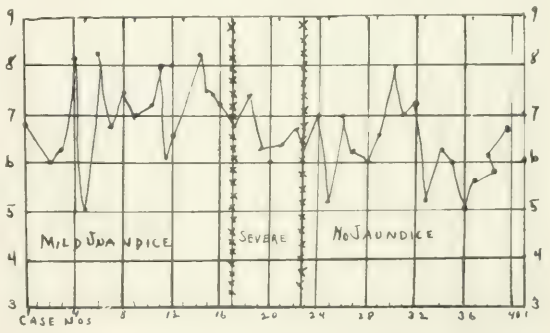

Chart 3. Showing no definite relationship between weight and appearance of jaundice. Horizontal lines indicate weight in pounds.

perature are apparently negligible factors. Stored in every newborn there is an amount of liver iron that is definitely out of proportion to that in an adult. The particular purpose of it is not certain, although it may be that Bunge is right in saying that it is to make up for the iron deficiency in maternal milk. Fetal iron can originate from but one place and that is the maternal organism, through hæmolysis of her erythrocytes or from the other forms of iron being carried in soluble form in her plasma. The manner of its actual conversion and transportation is not definitely known. All the iron that is used by the fetal organism is utilized chiefly in the blood cells and to a small extent in soluble form in the plasma, the rest being speedily eliminated by bowel and kidney. Voit (5) showed by experiments on isolated loops of intestine that the bulk of iron was eliminated by the intestinal route. This gave us a clue as to where to look for our surplus iron. Specimens of amniotic fluid were collected before the membranes had ruptured and were tested for presence of iron. The tests were either negative or gave faint traces only, the clear amniotic fluid seldom showing presence of iron. Specimens of fresh meconium were washed and tested for iron, and again we found extremely small amounts, for example, less than one-twelfth of a milligram to ten grams of meconium. Since we found that neither the fetal intestine nor kidney is actively engaged in the excretion of surplus iron, we turned to the main organ concerned in fetal excretion, namely, the placenta, and here we found iron amounts proportionate to that which one would expect to find excreted in the fæces and urine.

Wells (6) states that the pigmentation of body tissues in the jaundiced depends upon the presence in them of bile pigments which usually have been formed in the liver and then reabsorbed in the lymph and the blood stream. The chief pigment in this condition is bilirubin and it may be elaborated in the liver cells primarily. There certainly is, however, a blood pigment hæmatoidin which is chemically identical with bilirubin, and this is formed from the breaking up of hæmoglobin in the blood vessel with the removal of the iron atom. The original experiments of Minkowski and Naunyn (7) apparently show that although there was hæmolysis in all cases of jaundice, no jaundice would appear if the liver were taken out of circulation, that is, no jaundice could appear without liver action. This may be partially questioned in view of the experimental work of Hooper and Whipple (8), who showed that the intravenous injection of hæmoglobin into dogs with the liver excluded from the circulation, would cause bile pigments to appear in the urine and in the fatty tissues. Under abnormal (9) conditions hæmoglobin can be changed in the peripheral blood vessels to bilirubin without the liver playing a part, as, for example, in paroxysmal hæmoglobinuria. Many observers (10), of course, have found bilirubin or hæmatoidin in hæmorrhagic effusions where the liver could not possibly interfere. Hammerstein (11) states that following asphyxia hæmoglobin is practically the only coloring matter of the blood found in solution in the plasma, and this might apply to infants with asphyxia at the expulsive stage or where the pains were so severe and frequent as to cause a partial asphyxia.

The question has been brought up repeatedly as to whether icterus of the newborn is purely hæmolytic, hepatogenous, or a combination of both. It is commonly accepted that the liver prepares iron-free bilirubin from the hæmoglobin of the erythrocytes and either excretes or preserves the iron for future use. With increased blood hæmolysis the normal liver function is unable to cope with the increased amounts of hæmoglobin brought to it and part of it passes unchanged into the bile. The bile becomes viscid, and stagnation and absorption occur behind the sluggishly advancing stream of bile. This apparently coincides with the fact that Mensi (12) found the livers of jaundiced children three times as rich in bile as those of the non-icteric. This so-called pleiochromia (13) is brought about by the dissolution of blood cells together with a resulting catarrhal inflammation of the smaller bile ducts. We feel, however, that the whole matter can be explained as a purely hæmolytic affair with the liver playing a minor part.

The extra hæmoglobin forming the excessive amounts of bilirubin apparently comes

from the destruction of the red cells, fetal, or maternal, or both. It is a well-known fact that maternal blood as such is never directly transmitted to the fetus, so that beginning changes and hæmolysis must begin at the trophoblastic layer of the placenta. DeLee (14) states that there is a hæmolysin present in fetal blood, and this might continue the destruction of maternal blood already begun at the placental barrier, but probably the term enzyme should be used instead of hæmolysin. Another observer (15) thinks that some of the maternal blood passes into the fetus and is there hæmolyzed as a physiologic process, while the opponent (16) declares that the process takes place wholly in the placenta, with the spleen and the endothelial reticulo system continuing the destruction after birth until equilibrium has been reached. The fetal apparatus for blood regulation and manufacture is unstable at best, and the work of numerous investigators has shown the presence of nucleated reds, variation in size, and the so-called "ghosts" in the blood of the newborn, all pointing toward an instability of the blood-producing apparatus. Lichtenstein (17) declares that the increased iron found in premature babies is due to a deficiency in the blood-producing apparatus and consequently a breakdown in iron metabolism.

The curve of the red cells together with the hæmoglobin curve and their decline follows quite accurately the appearance of jaundice and its duration, or in other words with the blood hæmolysis, until equilibrium has been reached. Leuret (18) found occasional cases with hæmoglobin free in the blood plasma, and we were able to demonstrate this repeatedly. Biffi and Galli (19) found the blood plasma richer in bile pigment during the first week than at any other time.

The contention that the pigment in icterus neonatorum is largely of hæmolytic origin is further borne out by the statement of Rolleston (20) and Schiff and Farber (21), who claim to be able to distinguish chemically between bilirubin of obstructive jaundice and that of hæmolytic jaundice by means of the Ehrlich diazo reaction. In mechanical jaundice, according to this view, the bilirubin secreted by the liver cells enters the circulation as a result of obstruction and reabsorption; in dynamic or hæmolytic jaundice the bilirubin is produced by the entire reticulo endothelial system and circulates in the blood without first passing through the liver. The bilirubin of the first type gives a direct diazo reaction and the second an indirect; that is, the violet color appears only on the addition of alcohol in the latter. In all newborn children they found the bilirubin to be of the hæmolytic or dynamic type, although every patient was not necessarily jaundiced. This work has repeated in adults by Sabatini (22) and McNee (23).

We tested the jaundiced cases after the modification of Van den Bergh, (24) and we learned that accuracy in amounts used together with strictly fresh solutions, especially of the nitrite, were necessary for success. Twenty-five cubic centimeters of the sulphanilic solution was mixed with 0.75 cubic centimeter of the nitrite solution. For direct test 1 cubic centimeter of this mixture was added to 1 cubic centimeter of serum to be tested and if the jaundice was of the mechanical type the characteristic red rose color appeared. For the hæmolytic or dynamic type 1 cubic centimeter of the serum was mixed with 2 cubic centimeters of 95 per cent alcohol and the tube centrifuged until clear. To the supernatant clear fluid 0.25 cubic centimeter of the Ehrlich mixture was added and the red color, turning to violet, would appear in from 1 to 8 minutes. The striking thing, however, was that not only did we obtain the secondary test with the early jaundices but also that, when the jaundice had persisted for 8 days, during which time there should have occurred liver irritation and stasis if there was to be any, we still obtained the secondary or dynamic test reaction. We then repeated our tests on cases of known bile obstruction in adults and found the first test always appearing, as have other observers (25). This adds distinct strength to the contention that the icterus of the newborn is wholly hæmolytic.

Schiff and Farber also found bilirubin in the blood stream in all their cases. Lucas (26) and others demonstrated in the majority of the newborn of their series the presence of bilirubin in the blood stream although all were not icteric. Hirsch (27), in similar fashion,

demonstrated the presence of bilirubin in the serum of the umbilical cord, and the degree and the day of onset of jaundice was relational to the amount of bilirubin found.

Since there is little doubt that there is a surplus of bilirubin in the blood of the newborn, the question is to be answered as to where the excess of iron is deposited. Previously in this paper it has been mentioned that the meconium and amniotic fluid contain merely traces or no iron at all, thus ruling out the usual paths of excretion, namely, the kidney and the intestine. In contrast to other theories we have found definite iron amounts in the placentas, and in each instance a definite relationship between the amount present and the degree and extent of jaundice. The work of Slemmons (28) has clearly shown that at the surface of the chorionic villi, the maternal and fetal blood streams meet and exchange food-stuffs and waste products. It would seem probable that here the villi act as do the villi of the adult intestine, and thus the iron is deposited in the placenta or is transferred to the maternal blood stream for elimination. The amount of iron in the placenta would represent the amount which the fetus did not utilize and which the maternal blood stream did not eliminate through kidneys and intestine.

CONCLUSIONS

1. All newborn infants have bilirubinæmia corresponding to the iron content of the placenta.

2. There is a definite relationship between icterus neonatorum and placental iron content, the greater the placental iron content the greater the clinical jaundice.

3. Jaundice of the newborn may thus be considered as purely dynamic or hæmolytic in origin.

4. The non-icteric infants, all of whom, nevertheless, have a certain degree of bilirubinæmia, are without jaundice because their placental iron content is below the level necessary for the appearance of jaundice.

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TUMORS OF THE BREAST[1]

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I HAVE recently reviewed 107 cases of tumor of the breast which have come under my care. I have analyzed these cases from the clinician's point of view, and have divided them into five classes:

1. Clinically cancer. Tumor of the breast accompanied by a sufficient number of signs and symptoms to justify the diagnosis, that is, they presented those signs and symptoms which make the diagnosis unmistakable. There were 64 cases, 60 per cent, in this group.

2. Potentially cancer. Tumor or induration of the breast which is permanent, but is not accompanied by a sufficient number of signs and symptoms to justify a completed diagnosis of cancer, but having those elements which are commonly found in the precancer stage. There were 26 cases, 24 per cent in this group.

3. Doubtful cases. Tumors or indurations of the breast which are soft and of doubtful permanency unaccompanied by other signs or symptoms, but which at the same time make it imperative that the patient be under frequent observation, until they either disappear or their permanency is established. There were 13 cases, 12 per cent in this group.

4. Inoperable cases. Cases in which other organs than the breast or the glands are involved, or, in which the resistance of the patient is so reduced as to make even a palliative operation impossible. There were 4 cases, 3.5 per cent in this group.

5. Microscopical diagnosis, both primary and for confirmation. Primary microscopical diagnosis should not be undertaken except where facilities are at hand to complete it and act on its results during the operation. There were 51 cases (48 per cent) in this group. The cases in this group are also comprised in groups 1 and 2.

Of course, microscopical examination of the excised tumor, breast or glands, is always desirable as confirmatory evidence of its character.

The cases studied do not include all which have come under my observation, for the reason that my early cases were not carefully enough recorded, and some of the late cases were only seen once or twice, and the record was not sufficiently complete and uniform to be of value. Others were operated upon away from the hospital. The study points out the desirability of a uniform system of records from the beginning of one's practice.

In all the cases the method of treatment is based on the clinical diagnosis; the microscopical diagnosis has been used only to fortify the clinical diagnosis. Many recent studies of carcinoma of the breast have shown how frequently the clinical diagnosis is at variance with the microscopical. In this series 18 per cent of those reported benign by one of our best laboratories had recurrences within the first 2 years.

This study of a group of cases of tumor of the breast has been stimulated by three principal considerations:

1. A desire to know what my results have been.

2. The fact that the teaching regarding the diagnosis of cancer of the breast in our medical schools is not always in harmony with the best of the most recent developments on the subject. As an examiner in surgery of candidates for license in Illinois, I found that fully 90 per cent of all the candidates, whether recent or old graduates, failed to answer in a satisfactory manner the question "Describe an *early* case of cancer of the breast, and outline treatment." In fact they showed plainly that they had not been taught the signs and symptoms of early cancer, not to say anything of potential cancer. Pain, retracted nipple, dimpling, enlarged glands, immobility of mass, or emaciation, were to be found in 90 per cent of the answers, yet these are all admittedly late signs and symptoms. The only conclusion is that the teaching in our schools does not place sufficient emphasis on early and potential cancer.

[1] Read before the Western Surgical Association, St. Louis, Missouri, December 1, 1921.

3. Much of our book literature, even some which is quite recent, is not in harmony with the latest developments of the subject. For example, a recent work on surgical diagnosis contains a scant four pages on "Neoplasms of the Breast," and does not contain a suggestion of the impossibility of arriving at an early differential diagnosis. The author does not call attention to the fact that benign neoplasms quite frequently prove to be malignant, and that all neoplasms of the breast must be regarded with great suspicion. One would be led to think that the differential diagnosis consisted in following out a simple set of rules as to the hardness, mobility, etc., of the growth.

A study of some recent books will reveal the frequent use of such loose expressions as "generally," "as a rule," "usually," "more frequently," "early enlargement in the axilla," "pain as an early and marked symptom," "early cachexia." Such expressions in dealing with this disease are, to put it mildly, pernicious, and do not help the reader to arrive at a proper conception of the subject. A common fault is that there is so little attempt to differentiate early from late cases, and often no suggestion that a so-called benign growth may speedily become malignant, or in fact may already be malignant although all clinical signs favor a diagnosis of benign tumor. A number of authors fail to point out the great difficulty in arriving at a diagnosis, and the numerous sources and causes of error. They fail to bear down upon the fact that tumors of the breast may contain elements of malignancy which are impossible to diagnosticate. One cannot analyze a group of cases without being confronted frequently with the fact that a tumor, which by all the older rules of diagnosis was believed to be benign, has unexpectedly proved to be malignant. Authors have not been sufficiently insistent on the fact that the patient's life is staked on an early diagnosis.

The following observations and deductions seem to be justified by this clinical study as well as from a study of the latest and best literature of the subject.

In dealing with this subject it should be a maxim that all benign tumors of the breast may become malignant, and that some tumors which seem to be benign may already be malignant. My statistics show plainly that if this policy could always have been faithfully followed, several secondary operations would have been avoided and several lives saved. A careful study of benign tumors shows that each one in turn has frequent exceptions when it is found to be malignant (8).

When we come to consider treatment of tumors of the breast it is nothing short of a surgical crime to await an accurate pathological diagnosis. Some of the commonest diseases of the breast may lay the foundation for malignancy, and there is no way in which we can tell whether or not in a given case malignancy has already taken place. Chronic interstitial mastitis is often confused with carcinoma. In fact it seems to be well established that malignancy may occasionally give rise to chronic mastitis (5). Chronic cystic mastitis is an even more dangerous condition, and breasts which are clinically described as cystic should always be regarded as dangerous, as malignancy may already be present (5). Cysts of the breast are commonly of duct origin, and the ducts may already contain the beginnings of malignancy. The smallest and most freely movable adenomata may prove the starting point for a rapidly growing cancer (2).

Metastasis has been known to take place notwithstanding the fact that the microscope reported a non-malignant fibro-adenoma. In my own cases 18 per cent that were pronounced benign by one of our best laboratories had recurrences. This is not a criticism of the laboratory but emphasizes the difficulties of diagnosis. The time has come when we must admit that a positive clinical diagnosis of cancer of the breast cannot be made sufficiently early to justify using it as a basis for surgical treatment. How are we to say that a given growth which is clinically benign does not already contain elements of malignancy? A growth which is benign this month may be malignant next, or more likely already contains elements of malignancy (13).

Much effort has been spent, by some authors, to make a differential diagnosis between

benign and malignant growths, and the following quotation from a well-known author well describes the futility of the effort.

"If the tumor (breast) has only been present a matter of months it is probably cancer, if a year or more it is fibro-adenoma. Further fibro-adenoma not rarely undergoes cancerous changes, and this alteration is not signified by any recognizable clinical symptoms" (13).

We cannot rely upon time, as a principal element in arriving at a differential diagnosis. Carcinoma may originate in a breast and be present for years without giving rise to a palpable tumor (11).

Is it not a situation where we are driven to the conclusion that all benign tumors of the breast should be removed? For the very good reason that a positive differential diagnosis is impossible (10). Instead of elaborate efforts at differential diagnosis would it not be better to adopt the maxim that "Any lump in a woman's breast is better out than in?" (10).

The onset of cancer of the breast is so insidious that we have little to guide us in its early stages except the presence of a growth. Usually the patient feels no pain but simply discovers a lump in the breast accidentally. There is no accurate way to know how long it has been in the breast (12). We may be able to make a positive diagnosis of a benign nodule in a breast and the microscope may reveal a cancerous development at a distance in a duct (9). A recent author suggests that no benign tumor of the breast ever becomes more benign, (6) and concludes with the advice that all benign tumors should be removed. It is a question whether it would not be safer, for the great majority of patients, if every breast containing even a benign tumor was removed. Would it not be better to accept the dictum of a prominent author who says, "The early removal of a hundred unproved tumors is better than to deny one woman deliverance from cancer of the breast." (7) Should we adopt such a dictum we will certainly save many women. By the law of averages we know that the great majority of tumors of the breast are either malignant at the time of observation or will soon become so. Is it not a fact that the great variation of malignant forms renders it imperative that all mammary growths should be removed? (13). If we are to do the greatest good to the greatest number, operations must be done in a number of questionable cases in order to give the patient the benefit of the doubt (1). There is certainly a growing feeling among surgeons that all tumors of the breast, whatever the belief as to their character, should be removed rather than await the signs and symptoms by which a positive diagnosis of cancer can be made (12).

There is another reason for removing the whole breast in cases of tumor, especially those where there can be the least doubt as to the existence of malignancy. A comparatively recent report (The Johns Hopkins Hospital) seems to show that where the indurated mass of chronic cystic mastitis is removed and a microscopic examination reveals carcinoma, even though a radical operation is done within a few days the patient may not be expected to live more than 3 years (5). The following rules have been adopted by some hospitals and are worthy of serious consideration.

1. In patients under 30, with chronic cystic mastitis a partial excision of the breast may be done in selected cases.

2. In patients between 30 and 40 with chronic mastitis the breast, fascia, and pectral muscles should be removed.

3. In patients over 36 with chronic cystic mastitis, a radical operation should be done (5).

4. In every case of doubt in chronic cystic mastitis the patient should be given the benefit of the doubt and a radical operation should be made. The same rules should be applied to a number of other breast conditions.

The danger of cancer transformation in these cases is especially menacing, as it is also in painful subcutaneous fibromata (2 and 5). The only cases of tumor of the breast where the growth alone can be removed with reasonable safety are small, recently developed nodules in women under 30 years of age. Where a tumor is of moderate size or has shown any recent tendency to increase in size the whole breast should be removed (10).

Where any considerable portion of the gland is involved the whole breast, fascia, and

muscles should be removed as early as possible (10). Occasionally cases are seen which seem to exhibit primary carcinoma of the axillary glands. In such cases a careful search of the breast tissue will probably reveal the original cancer focus (11). While an excision should be done in every tumor of the breast, in most cases this will prove insufficient, and secondary operations for removal of the breast are unsatisfactory. We must always keep prominently in mind that to withhold early operation in any case which may prove to be cancer may condemn the patient to a wretched and unjustifiable death. A few months' neglect under the guise of an attempt to cure by palliative treatment, so called, and hope may be gone forever (7). If every tumor of the breast were operated upon immediately upon the discovery of the lump the great majority of cases of cancer of the breast would be prevented or cured. By promptly removing indurated areas and benign growths, and by preventing and curing mastitis, we will do much toward preventing carcinoma (7). There should be no long period of observation in any doubtful growth in the breast. Neither should there be any half-hearted surgery for cancer of the breast. Unfortunately, the teachers of surgery, as well as the surgeons in active practice, need to be more thoroughly impressed with the fact that the only hope of cure rests on early and complete extirpation and not on prolonged effort at a differential diagnosis. To our disgrace, the majority of patients with cancer come to operation too late to be cured. Using the words of a prominent author, "Most cases of cancer which come to the surgeon are, alas, too easily diagnosed." (7).

I have often wondered just what we understand, each one for himself, by the cancer question. The backbone of any movement for the prevention, as well as the cure, of cancer, must be the medical profession, and until we are more alive to a more hopeful and rational view of the handling of cancer, little progress can be made. Following Virchow's announcement of his cellular pathology, the whole energy of the profession was devoted to the determination, by the use of a microscope, whether or not a given tumor mass contained cancer cells. We were taught to consider it a disgrace for a surgeon to remove a growth as cancerous and have the pathological report show that it contained no cancer cells.

This theory contains two important fallacies; first, that it is possible to make a clinical diagnosis of cancer in a given case; and, second, that it is not possible for the pathologist to detect all cancer cells in a given tumor by ordinary methods.

I judge that the great majority of physicians still hold these fallacious views, the repeated failure of which has brought about much of the present hopelessness regarding the treatment of cancer. Such a view also has an important relation to our methods of diagnosis.

Suppose that the question was asked of a hundred physicians at random, what are the signs and symptoms of early cancer of the breast. What do you suppose would be the answer? What element would they depend upon for an early diagnosis? Remember that the emphasis is placed on the word *early*.

From my experience with State Board Examinations mentioned above, I am led to fear that fully 90 per cent of our physicians would answer the question in a very unsatisfactory way. In other words, their early diagnosis would contain such elements as pain, enlarged glands, retraction of the nipple and dimpling in breast cases and even emaciation and cachexia. As a matter of fact, all these signs and symptoms are late, very late. When a patient consults a doctor and presents a tumor mass, with enlarged glands, pain, emaciation, etc., we have already an advanced case of cancer. Just here is where we are failing as a profession to give the people the benefit of the latest and best teaching regarding cancer. In fact, if we are to give the greatest aid to cancer cases, we must bend our best energies to prevention and not to an effort to eradicate the already fully developed disease.

As a profession we are wasting time for the patient in trying to make a positive pathological diagnosis before we initiate appropriate radical treatment. We are neither teaching nor practicing the treatment of

potential cancer. I take it that the trouble with the cancer question is with the medical profession itself, rather than the people. There is every indication that the people are anxious to learn about cancer. About every case I see has previously been examined by one or more physicians, who have used more effort to allay the fear that the lump she or he has may be cancer, than to institute vigorous radical treatment at a time when such treatment will be most effective.

DATA FROM PERSONAL CASES

The cases comprised in this study were referred by 40 different physicians; only a small proportion of them came to me primarily.

The following data give the fundamental facts regarding the 107 cases studied.

Sex:

	Cases
Males	2
Females	105
	107

Civil condition:

	Cases
Children	2
Married	66
Widows	14
Single	25

Married, 85 per cent; single, 15 per cent.

Age:

Under 1 year	1	
15 to 20 years	2	10 per cent
20 to 30 years	8	
30 to 40 years	30	60 per cent
40 to 50 years	34	
50 to 60 years	12	27 per cent
60 to 70 years	11	
70 and over	7	
Unrecorded	2	

Occupation:

	Cases
Infant	1
Student	2
Housekeeper	1
Bookkeeper	2
Nurse	4
Seamstress	8
Teachers	8
Housewives	76
Farmer	1
Cigarmaker	1
Not stated	3

Time elapsing from first appearance of a lump in breast to first observation by surgeon:

	Cases
Less than 6 months	23
6 to 12 months	5
12 to 24 months	18
24 to 36 months	11
36 to 48 months	2
48 to 60 months	2
60 to 72 months	2
72 to 84 months	1
Not stated	43

The tumor has been observed by the patient for more than a year in 58 per cent of cases. Not infrequently they had been under some form of treatment much of the time.

The main interest in this analysis centers around that group of cases which was *clinically cancer* (Group 1) at the time they consulted the surgeon. The following facts apply to these cases:

	Cases
Total number of cases	64
Number of cases operated upon	60
Total number of operations	87
Recurrences following operations	42
Cases having no recurrences	18
Well at end of 1 year	2
Well at end of 2 years	8
Well at end of 3 years	4
Well at end of 4 years	2
Well at end of 5 years	18
Total number of patients well November 1, 1921	34

	Cases
Well at the end of 5 years.....per cent	30
Well from 3 to 5 years.....per cent	40
Well from 1 to 5 years.....per cent	56
No report received from	12
Inoperable	4
Microscopical report of cancer	33
Microscopical report of no cancer	16
No microscopical examination	27
Operative mortality	0

Five patients who had recurrences and were re-operated upon lived 5 years or longer.

Only 12 per cent of the cases which had fully developed clinical signs were well after 5 years.

Number of cases of *potentially cancer*	26
All advised to have nodule removed for microscopical examination.	
One case which was congenital has since been operated upon, and microscopical examination showed growth to be benign.	
Lost sight of, having been seen only a few times	5
Still have nodule but no other development, although there is still ample opportunity	5
Either the tumor or the whole breast removed	15

Cases originally classified as "potentially cancer" were transferred to the "clinically cancer" group, upon finding enlarged glands in the axilla which could not be palpated 8

Doubtful diagnosis 13
These could not be followed; several were observed only a few times. All were advised to report at least every 3 months for examination. No operation advised.

The following facts were recorded:
Primary soft or undefined nodule in the breast 7
Recurrent nodule in breast, axillary glands, or scar from previous incomplete operation 12
Primary hard nodule in breast 89
Whole breast a mass 13
Retracted nipple 14
(This does not include the cases where the whole breast was a mass, because in practically all these cases the nipple was retracted.)
Dimpling 6
History of injury 8
(A number attributed pressure of clothing as a cause, but this was more or less uncertain.)
History of infection 7
Axillary glands on the same side involved. 54
Cervical glands enlarged 11
Mediastinal glands involved 2
Pain a factor in 44
Recurrence in the scar 18
Recurrence in the cervical or mediastinal glands 7
In several cases recurrence in sites named.
Postoperative swelling of arm 6
Recurrences were as follows:
After primary nodule was excised including the cases in which the nodule was excised for diagnostic purposes and complete operation was done later 16
After the breast was excised 3
After the breast, muscles, and glands were excised, that is, complete operation 7
Several cases had more than one recurrence as follows:
2 recurrences 9
4 recurrences 1
Primary nodule excised and followed by complete operation and no recurrence in 8
Primary excision of breast only in 6
Recurrences in 3
Total number of operations in all groups.. 102
Four operations 3
Three operations 4
Two operations 15
Refused operation 15
Observation advised in 10
(No operation required.)
Cases classed as "potentially cancer" reported by laboratory as positive as to cancer 7
(This transferred another group which I had originally classified as "potentially cancer." This group originally contained 41 cases but developments at operation reduced number to 26.)

I cannot say that I am extremely proud of my results in cancer of the breast but I place them before you, such as they are, with the hope that by a frank presentation and discussion we may develop new energy and take new hope in dealing with these cases.

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STRICTURE OF THE BULBOUS REGION

By Dr. GERMAN DIAZ LOMBARDO, Mexico City, Mexico

STRICTURES of the bulbous region which in many cases are the result of blenorrhagia, are frequently found. Such strictures, as well as all those of the urethra, for their study may be divided clinically into recent and chronic. We shall not consider recent strictures in the present study as they are not far enough advanced, and as a rule they are treated as are any urethral strictures.

In studying chronic strictures, we must bear in mind the anatomopathological lesions of the affected area and the deformities and lesions behind the stricture.

Referring to the lesions in the region of the stricture, nothing can be said of special interest except that the urethra tends easily to contract after dilatations. As to the lesions behind the stricture I would call attention to the dilatation of the entire posterior urethra, a somewhat important factor. This dilatation is so great and the membranous urethra and the prostatic urethra expand to such an extent that it might be said they form in some cases a prevesical cavity. Probably, on account of this exaggerated dilatation, the neck of the bladder is found rather high. Even though this position may be the result of the dilatation I wish to state that in such cases I have found the neck of the bladder of a fibrous consistency, which makes it very resistent to dilatation.

Because of the facility with which stricture of the urethra occurs at this point, because of the extensive dilatation of the posterior urethra, and because of the fibrous consistency of the neck of the bladder, I am convinced that treatment by progressive dilatation does not overcome the difficulty, but, on the other hand, I feel that it may help to increase the trouble; for instance, it may aggravate an inflammatory condition of the verumontanum. As I have said I will consider here only chronic strictures, that is, those in which there are present dilatation of the posterior urethra and the cavity I have referred to. This cavity in some cases I have operated on has been very large. Therefore, it seems to me, that the therapeutic problem in such cases is to restore the urethra to its normal caliber and to eliminate the cavity. Dilatation of the stricture by catheter, as I have said, does not give permanent results. However, even if it were possible by such a manœuvre to restore the urethra to its normal caliber, there is still the problem of correcting the dilatation of the posterior urethra, and this cannot be overcome with catheter nor by means of extensive dilatation of the neck of the bladder which would be necessary in order to overcome its fibrous state.

Dilatation of the posterior urethra, which is generally infected, probably results in retention of small quantities of urine, and that, in turn, leads to chronic inflammation of the region and of the verumontanum. This last condition is associated with some important symptoms, among which may be mentioned impotence, urethral neuralgias, and neurasthenia. Patients thus afflicted and incorrectly treated by means of dilatation and catherization get well under the treatment but, when catheterization is suspended, the condition promptly recurs, and with each recurrence the urethral symptoms and the local and general manifestations are more marked and rebellious to treatment. For this reason I have for some time past adopted the practice of operating upon these cases.

The technique consists in making a large, internal urethrotomy (Otis), so as to insert at the point of stricture a No. 60 Beniqué. An external urethrotomy is made to reach the neck of the bladder, which is dilated from 1.5 to 2 centimeters. If necessary little cuts are made in it. Treatment of the cavity, which is the result of dilatation of the posterior urethra, consists either in breaking up the adhesions of the posterior wall of the urethra to the posterior urethral wall when the cavity is not large, or if the cavity is large in resection of a portion of urethra from the prostatic

and membranous region. As, for 3 or 4 days, the posterior urethra is canalized by the perineal section, this drainage assists the desinfection of the cavity, and, therefore, the treatment is complete.

I have operated upon ten cases this year and in these patients I have been able to study this important region, the posterior urethra. In some of them I have found a real diverticulum, and I have afterward been able to demonstrate that after operation the urethra still has a large caliber and that the cavity has decreased in size or has disappeared. The ease with which vesical catheterization is accomplished and urethroscopic examination is made establish the fact that the cavity has been modified. All the patients are very well pleased with the results of their operation.

CONCLUSIONS

As I have said, I believe that recurrences are the cause of urethral papillomata, impotence, urethral neuralgias, and neurasthenia, and that treatment by progressive dilatation is only palliative and less permanent after each relapse. For these reasons I purpose to go on studying the treatment described, and I shall continue to follow up my cases so as to confirm more strongly my conclusions which at the present time may be stated as follows:

Treatment of strictures of the bulbous region is imperative to prevent chronic inflammatory lesions of the verumontanum or to cure them when they exist.

Progressive dilatation results in neither prompt nor permanent cure.

OBSERVATIONS ON TWO THOUSAND FOUR HUNDRED AND SIXTY EIGHT HERNIA OPERATIONS BY ONE OPERATOR

By JOSEPH P. HOGUET, M.D., F.A.C.S., New York

THIS paper is an account of my experiences in operating on one of the common surgical conditions, namely that of hernia, from 1910 to the present time. In this period I have performed 2,468 operations for hernia of various kinds. It has seemed to me that a description of such a series of cases by one operator with a report of the results obtained might be of interest. In the *Annals of Surgery* for September, 1918, Dr. W. B. Coley and the writer gave the results in 8,864 cases of hernia, but this report included operations done by at least a dozen men and the earliest cases dated back to about 1890 when the operative technique was far from perfect. In the last 10 years, the technique used in operating upon the commoner types of hernia, with the possible exception of direct inguinal variety, has been well systematized and of a number of different kinds of operations, only a few have withstood the test of time and have been almost universally adopted as the best. Profiting by the experience of the operators of former years, I have employed the operations which most surgeons have deemed to be the most successful, and I present here the results of my experience with these operations.

In tracing results, the usual difficulties have been met. The population moves frequently in large cities but by means of the modern follow-up systems and by reply postal cards, sent out every year, the results have been obtained in a large percentage of cases.

As the type of hernia and the results of operations differ very much in children and adults, it was decided to divide each type according to age, and the age of 15 was arbitrarily chosen as that which differentiated a child from an adult. It was thought best to describe each kind of hernia separately.

INGUINAL HERNIA IN CHILDREN

The majority of the children in this series were operated on between the ages of 4 and 12. Many were operated on in the first year of life, but these were the exceptional cases where the hernia was so large that there was a real danger of strangulation and where on account of its size, it had a definite effect on the child's general health. It is usually my practice to advise the use of a truss, when the hernia is small, up to the age of 3, but when either of the two conditions mentioned above are present, there should be no hesitancy whatsoever in advising operation. The danger of respiratory complications is probably very much exaggerated and can be materially lessened by the administration of ether by the drop method by an expert, and it should be remembered that in these cases, only enough anæsthetic is necessary to keep the child from moving. A deep anæsthesia should never be employed. The only other danger is that of postoperative contamination of the wound with urine. This can easily be avoided by the use of the dressing advocated by the writer a number of years ago and used successfully in a number of cases. In these young patients, when the skin is sutured, the first dressing is made of separate layers of gauze, saturated with collodion so that the edges of the dressing are hermetically sealed to the skin. Over this a compress soaked in liquefied vaseline or boric acid ointment is applied and is changed as often as it is found to be wet with urine. The collodion dressing need only be changed about the eighth day.

In this series there were 745 operations for indirect inguinal hernia and 3 for direct inguinal hernia in boys under the age of 15. The Bassini operation, with transplantation of the cord, was done in most of these cases. The same operation was done in the three direct hernias as these patients were found to have such good musculature that a rectus transplantation was not deemed to be necessary.

There were 79 cases of indirect inguinal hernia in girls under 15 and not a single direct hernia. In these cases, the Bassini operation

was also employed, the round ligament being dissected from the sac and not transplanted.

This makes a total of 827 operations for inguinal hernia in children of both sexes under 15 and in this series not a single recurrence has been found to date. This, of course, is a great argument for operation in early childhood. There was not a death among these 827 cases. Postoperative complications have been exceedingly rare and have been limited to a few cases of bronchitis and a few of mild acidosis. Nothing approaching a real pneumonia has been seen.

INGUINAL HERNIA IN ADULTS

There have been 963 operations for indirect inguinal hernia in males over 15. In the great majority of these cases, the Bassini operation, with transplantation of the cord, has been done. This, to the writer's mind, is the ideal operation for this type of hernia, especially with the use of one suture above the cord at the internal ring and with the inclusion of the reflected aponeurosis of the external oblique in the lowermost suture at the inner part of the canal next to the pubic spine. In a few cases the Wyllys Andrews and the Halstead operations have been done. In a small number of patients where the cord was very thick, the Bassini, without transplantation of the cord, was done. In 8 cases where the conjoined tendon was unusually weak, the rectus muscle was transplanted in addition and in another 8 cases, for the same reason, the reduplicated aponeurosis operation was employed.

In this series of 963 operations, 16 recurrences have been found up to the present time, or a percentage of 1.6. Two of these recurrences were in operations for recurrent hernia. There were 4 deaths. One was from acute yellow atrophy of the liver in a man of 45, where chloroform had been used; and 1 in a man of 81 from cerebral embolism. This case was done under novocaine for a partially incarcerated and very painful hernia. Two of the deaths were in strangulated cases where a general peritonitis was already present at the time of operation.

There have been 108 operations for indirect inguinal hernia in women. Contrary to the writings in most textbooks, this condition is much more common in women than the femoral variety. In all of the cases of this series, the Bassini operation was found to be most satisfactory, the round ligament being easily stripped off from the sac, dropped back, and not transplanted. That this condition in women is easily cured is proven by the fact that, in this series, there has not been a single recurrence up to date. There was one death, however, in a woman of 45 who suddenly developed an acute nephritis on the fifth day after operation.

There have been 76 operations for undescended testis in boys under the age of 15 and 42 in men above that age, making a total of 118. The majority of those under 15 were operated on from about the eighth to the twelfth years and those over 15, at about the age of 25. In all of these cases, the Bevan type of operation was done, with or without the division of the spermatic vessels, depending on the length of the cord. Complete division of all of the vessels of the cord was done in a number of cases and in none was it found to have any bad effect on the growth of the testicle, either immediately after the operation or in later years. Where the testicle is exceptionally high and where, even after division of the cremasteric fascial bands and the spermatic vessels, it cannot be brought down low enough, it has been found that the vas can be lengthened to the extent of about 1 inch by dissecting its terminal portion or the convoluted part of the epididymis away from the tunica vaginalis. In all but 3 cases of undescended testis, a patent funicular process has been found so that it must be remembered that this condition is practically always associated with a congenital inguinal hernia. In this series of cases there has been no recurrence of the hernia but the results as to the position and after development of the testicle have been very variable. It has constantly been found that when this condition, either in boys or in men, is accompanied by an underdevelopment of the scrotum, operation is always disappointing in its results even though the cord has been found to be long. In these patients, the hernia can easily be cured, but on account of the absence of the scrotum, the

testicle will generally not remain lower than the pubic spine. In a small number of cases, generally from the ages of 10 to 20, the undescended testicle has been found to be atrophic before operation and, in these, operative interference gives variable results. In some it is immediately followed by an increase in growth, and in others the atrophy has been continuous, so that in two cases the testicle was not palpable after about 1 year following the operation. It is my opinion that operation should be advised in all cases of undescended testicle after the eighth year and that the operation of choice is the Bevan operation with the continuation of the dissection of the proximal epididymis. There have been no deaths in this series.

The subject of direct inguinal hernia is most interesting. It has been my experience that the more of these cases that are seen the greater are found to be the variations of the anatomy of the inguinal region. . In many cases the conjoined tendon is well developed and the rectus muscle thin and narrow and in many others the former is represented by only a few sparse fibers and the latter is broad and thick. In all cases of direct hernia an indirect sac can be found. In the majority of the cases it is only a small peritoneal protrusion not more than an inch long, external to the deep epigastric vessels, and in some is seen the typical saddle-bag hernia where the indirect sac is as long as the direct. It is the conviction of the writer that the proceedings, as advocated by him in an article on direct hernia which appeared in the *Annals of Surgery* for December, 1920, are the correct ones. As stated above, we must realize that the anatomy of the inguinal region varies greatly, but the treatment of the sac is the same in all cases. After the incision of the skin and aponeurosis the protrusion of peritoneum external to the deep epigastric vessels should first be found, pulled up, dissected free, and opened. This protrusion always exists, and in some cases can only be demonstrated by a strong pull on the cord and retraction upward of the conjoined tendon. It is not necessary to divide the deep epigastric vessels except in very rare instances. In practically every case the peritoneum of the direct sac can be pulled out external to the deep epigastric vessels by traction on the indirect sac. In this way the two sacs are converted into one, and there is absolutely no danger of entering the bladder. If this method is not employed but the opening made directly into the direct sac, the bladder is certain to be entered in some cases.

STATISTICS OF 2,468 HERNIA OPERATIONS

		Number of cases	Recurrences	Per cent	Deaths
Indirect inguinal, male	Child	745	0		0
	Adult	963	16	1.6	4*
Indirect inguinal, female	Child	79	0		0
	Adult	198	0		1
Direct inguinal, male	Child	3	0		0
	Adult	249	17	6.8	2
Direct inguinal, female	Child	0	0		0
	Adult	7	0		0
Undescended testis	Child	76	0		0
	Adult	42	0		0
Femoral, male	Child	0	0		0
	Adult	22	0		0
Femoral, female	Child	4	0		0
	Adult	59	1	1.6	3†
Umbilical, male	Child	8	0		0
	Adult	12	0		0
Umbilical, female	Child	10	0		0
	Adult	37	3	8.1	2
Ventral, male	Child	1	0		0
	Adult	7	0		0
Ventral, female	Child	0	0		0
	Adult	26	1	3.8	1
Epigastric, male	Child	2	0		0
	Adult	6	0		0
Epigastric, female	Child	1	0		0
	Adult	1	0		0
		2468	38	1.5	13, or 52 per cent

*Two of these were strangulated.
†Two of these were strangulated.

The kind of operation that should be done for the repair of the direct hernia should be decided by the anatomy of the inguinal region in each individual case. Broadly speaking the following rules can be laid down: When the conjoined tendon is strong and the direct hernia not too large, a simple Bassini operation, with transplantation of the cord, should be done. When the conjoined tendon is thin and narrow and when the rectus muscle is strong and thick, a Bassini, with transplantation of the rectus muscle, is advised. When both the conjoined tendon and the rectus muscle are weak, a Bassini, with suture of the reduplicated aponeurosis of the external oblique, offers the best chance for a permanent cure.

To date, the writer has operated on 259 cases of direct inguinal hernia. Of these, 229 were true direct hernias in adult males, 3 were direct hernias in boys under 15, 20 were

of the so-called saddle-bag type of indirect and direct hernia in adult males, and 7 were of the direct type in adult women. No case of direct hernia in a girl under 15 was seen.

Seventeen recurrences have been found in this total of 259 cases of direct inguinal hernia up to the present time. The simple Bassini was done in 104 cases with eight recurrences, or a percentage of 7.6. The Bassini, with rectus transplantation, was done in 93 cases with five recurrences, or a percentage of 5.3, and the Bassini, with suture of the reduplicated aponeurosis, in 62 cases with four recurrences, or a percentage of 6.4. This does not correspond very well with the results described by the writer in a smaller series of 142 cases as published in an article in the *Annals of Surgery* for December, 1920, where the following figures were given: Simple Bassini with 7.3 per cent recurrence; Bassini, with rectus transplantation, with 2.8 per cent recurrence; and Bassini, with suture of the reduplicated aponeurosis, with 2.5 per cent recurrence.

There were two deaths after operation for direct hernia, both from embolism, one in a man of 53 and one in a man of 67. It must be remembered that this is a condition that occurs, for the most part, in men after 40, and in these complicated cases, the operation is more prolonged, and on account of the age of the majority of the patients there is a certain element of danger.

Contrary to the impression one receives from textbooks, femoral hernia is of comparatively rare occurrence. Only 85 operations, or 3.4 per cent of the whole series, were done for this condition. No cases were found in boys under 15, and only 22 were done in males over that age. Four operations were done in girls under 15, and 59 in women over that age. From these figures it can be seen that femoral hernia is comparatively common in men.

Practically all of these cases were operated on by the so-called purse-string method after removal of the sac, and a recurrence was found only once. This was in a thin, anæmic woman with a hernia larger than a big goose egg. In this series three deaths occurred, two of which, however, were in cases of strangulation, one complicated by resection of 8 inches of intestine. One young woman, a recent case in October, 1922, died of embolism, 5 days after an operation which was absolutely devoid of complications and which took less than 10 minutes to perform.

UMBILICAL HERNIA

Umbilical hernia is generally seen either in the very young or in persons past middle age. It is very common in young infants and in them it can practically always be cured provided treatment is instituted early enough with a pad and plaster and consistently carried out. Eighteen cases of both sexes under 15 years of age have been operated on by the writer. Either the horizontal or the vertical overlapping of the fascia gives excellent results in this condition and no recurrence has been found in any patient operated on in this way. Forty-nine cases of umbilical hernia in adult men and women have come to operation. It has constantly been noticed that men with this condition come to operation at an earlier age than do the women and that in the former the hernia is usually much smaller. In most of these cases the Mayo operation is to be preferred, although in a few, even though the skin be incised horizontally, it may be found advisable to overlap the fascia vertically. In this series there has been no recurrence after operation in the men, but there have been 3 out of the 37 among the women, or 8.1 per cent. Two deaths occurred among the women operated on for umbilical hernia. One, 38 years of age, died 7 days after operation from a pulmonary embolus and another of 68 was found to have torn out all of her sutures on the third day after operation, having suffered from excessive vomiting, and though the wound was immediately resutured, she did not survive.

VENTRAL, POSTOPERATIVE, AND INCISIONAL HERNIA

Ventral, postoperative, or incisional hernia is not very common. For the most part, it follows drained McBurney incisions or the drained median suprapubic incisions in women. Postoperative hernia in laparotomy wounds above the umbilicus is exceedingly rare. There are 34 operations for ventral

hernia in this series, 1 in a boy, 7 in men, and 26 in women. In all of these, the vertical overlapping of the fascia was done. A patient of this series with a hernia as large as a grape fruit was the only one that recurred. One death occurred in a woman of 60 from a pulmonary embolus.

Ten cases of epigastric hernia have been operated on. These are hernias of the linea alba or the linea semilunaris and are rarely larger than a walnut. Two occurred in boys, 6 in men and 1 in a woman. A characteristic of this form of hernia is that it is often accompanied by digestive symptoms. All of these openings were closed with one or two purse-string sutures after removal of the peritoneal sac, and none has been found to have recurred up to the present time.

It is interesting to note that only 23 cases of strangulation were seen amongst the 2,468 operations, and the majority of these were in very young children or in men and women past middle age. Only one strangulated inguinal hernia in a young girl was seen and in this case the tube and ovary were found gangrenous within the sac. There were 6 cases of strangulated hernia in young boys, the youngest being 9 weeks old and the oldest 6½ years. In none of these was the intestine gangrenous. Six strangulated inguinal hernias occurred in men ranging in age from 42 to 68. Two of these patients had a gangrenous loop of intestine and a general peritonitis at the time of operation and survived only a few hours. The only case of strangulated femoral hernia in the male was that of a man of 42 in whom the appendix was found caught within the femoral sac. Six women were operated on for strangulated femoral hernia, and it is interesting to note that one occurred in a woman of 81, one in a woman of 78, and one in a woman of 75. All of these patients survived, but one, aged 55, in whom the intestine was resected died, as did one, aged 49, in whom no resection was done. Three patients with strangulated umbilical hernias have come to operation. All were in women and all recovered.

It is the custom of the writer to operate on all strangulated hernias under a local anæsthetic with the exception of the very young children, to whom it is necessary to give only enough ether to induce a very light primary anæsthesia. In non-strangulated cases, local anæsthesia is used only in patients where, on account of age, cardiac, or renal disease, the use of a general anæsthetic is contra-indicated. The writer feels very strongly that in ordinary cases, the efficiency of the repair of the hernia depends on the dissection of the field and it is not possible to get as good an exposure when a local anæsthetic is used. Within the last 2 years, nitrous oxide and oxygen with a preliminary dose of morphine and magnesium sulphate has been used in several hundred cases with very satisfactory results. Patients anæsthetized thus will be conscious in a few minutes after termination of operation and will suffer from no nausea or vomiting.

ETHER LAVAGE; ITS LOGICAL USE, LOCALLY, AS AN ANTI-AGGRESSIN[1]

By GEORGE de TARNOWSKY, M.D., F.A.C.S., Chicago

EMPIRICALLY, ether has been officially on record as a local application to wounds since 1891, when Souligoux, of Paris, began its use. Curiously enough, although he treated several hundred cases of wounds and infections such as abscesses, lymphangitides, and erysipelas, with uniform satisfaction, he never sought any explanation of the beneficent reaction which he had obtained. It was also in 1891 that the same surgeon experimentally used ether in the peritoneal cavities of guinea-pigs, without any ill effects. These observations were, unfortunately for the sake of official priority, never published (1).

To the late Morestin (2), whose monumental work on plastic repair of war mutilations at the military hospital of Val-de-Grace, Paris, came to an untimely end in 1919, must be accorded official priority in the use of ether in peritoneal infections. On February 12, 1913, he reported his results at a meeting of the Société de Chirurgie, stating that he had: "Used ether since 1901 in peritoneal infections, either as a preventive disinfectant after suppurating salpingitis, in intestinal operations in which the bowel contents might have leaked, or as a curative method in grave cases of peritonitis due to perforating ulcers of the stomach or duodenum, or to acute appendicitis."

It was only natural that the advent of a new peritoneal antiseptic should have aroused suspicion, for in 1912, surgeons were pretty unanimous in their disapproval of any bactericide used in the peritoneal cavity. The clinical results, however, observed in Paris, in 1913, and later in my own service at the Cook County Hospital, were so gratifying that an attempt was made to abandon empiricism and seek a rational explanation for the beneficial effect of ether, used locally (3).

The chief questions to be answered were:

1. Did ether act as a liquid or as a vapor?

2. Was ether primarily a bactericide or a stimulant?

3. How long did the stimulant-irritant action last?

1. The answer to the first question was extremely easy. Ether volatilizes at 88° and boils at 95°F. In contact with living tissues, it becomes a vapor in approximately 20 seconds. Its cooling action as a liquid lasts only a third of a minute—to be immediately followed by the stimulant reaction of the vapor.

2. The bactericidal power of ether, though low, is nevertheless positive. In a series of 50 personal cases of suppurative peritoneal infections treated in 1914–1915, 5 cubic centimeters of pus were placed in a sterile test tube, 1 cubic centimeter of ether poured in and the mixture well shaken up before sending the tube to the laboratory for culturing. In the entire series, there was not a single growth reported. Controls were always added, in order to make certain that we were not dealing with sterile pus. Sklass (9) found that ether vapor would destroy spores because of their dehydration and would also arrest destructive ferments of organic origin. Phillips (29) carried out an extensive series of experiments with ether vapor, in order to ascertain its bactericidal power. Various strains of streptococci, staphylococci, and colon bacilli were used *in vitro*. In all strains, the resistance to carbolic acid was predetermined in order to obtain a comparison between the anti-bacterial power of ether and a known disinfectant. In general, the bacterial power of ether vapor corresponded to that of a 2 per cent carbolic acid solution. Similar experiments have been carried out by Sigwart, Fantozzi, Stadler, Jung, Pope and Warnecros. Phillips sums up his observations by stating that: "The conclusion that may be permitted from these experiments is that—even allowing for the entirely different behavior of individual bacterial strains against ether vapor—it can

[1] Read before the Chicago Gynecological Society, January 19, 1923. (For discussion see p. 98).

be admitted that germs located upon the surface of the uterus, even stubborn streptococci, can be killed with sufficient concentration and sufficiently long exposure to ether vapor. Both factors may be increased as desired, such procedure being, according to Warnecros, without danger. The fact that under high temperature and strong pressure ether vapor can reach the deeper lying germs, is especially favorable. By the introduction of ether vapor into the uterine cavity which is infected, we have, therefore, a mode of treatment calculated to supply a powerful acute therapy in septic abortion."

If ether possesses this definite bactericidal power, why should it not also permanently damage living tissue cells and create permanent adhesions? Its great volatility, rapidity of diffusion, and evanescent action, and the fact that it is the only solution used in the treatment of wounds and infections which vaporizes instantly without leaving any residue, explain this apparent paradox and, in our opinion, places ether in a class by itself.

Is ether a stimulant? Clinically, when ether is poured on living tissues, there is a primary contraction of arterioles and a sensation of cold followed, as soon as the boiling point is reached, by a violent though transitory hyperæmia accompanied, if the patient is not anæsthetized, by a sensation of warmth. Peritoneal irrigations have long since been abandoned by the majority of surgeons because of the physical impossibility of any fluid reaching the many pockets and fossæ of this cavity. As a gas, however, ether vapor is under tension and must follow the universal law of diffusibility of gases; consequently it must and does in fact penetrate every pocket, fold, and corner of the peritoneal sac, giving rise to a general, not local hyperæmia. If we recall the fact that serous surfaces are at all points capable of active phagocytosis, on account of the abundant diapedesis of white blood corpuscles which accompanies hyperæmia, we will grasp the essential *raison-d'être* of ether lavage. Because of this lymph-channel blocking hyperæmia, absorption by the serosæ is comparatively slow and there is no danger of deepening narcosis. Ten years ago it was customary to stop the anæsthetic after the local use of ether; this is unnecessary and has been discarded. Likewise, as soon as it was realized that we were dealing with the effects of ether vapor and not ether liquid, the lavage of Morestin and Souligoux—which went so far as to consume one liter of ether in a peritoneal cavity—was abandoned, and one ounce or less, depending on the cavity and its distensibility, was found to be sufficient. As pointed out by Santy (8), serous absorption of ether is a physical phenomenon due to hypertension of vapor which thus reaches the capillaries and general circulation. The same author also states that the toxic action on the endothelium is not intense because contact lasts only 10 minutes.

In order to determine the stimulant or anti-aggressin power of ether, leucocyte counts were made on thirty clinical cases of local or general peritonitis, immediately following the operation and 12 and 24 hours later. Using the pre-operative blood-count as a control, it was found that a hyper-leucocytosis of from 2000 to 5000 per cubic millimeter resulted from the local use of ether. Lienhardt (4) in 1921 obtained the same results. Reviewing the question of peritonitis, he found that collective statistics placed its mortality at somewhat over 40 per cent. In 101 personal cases of peritonitis treated by ether lavage, Lienhardt found that he had reduced his mortality to 27.7 per cent. Ether lavage, he states, has a very favorable influence on the healing process of peritonitis. It produces a local reactive inflammation, exudation, and increased production of antibodies, and thus tends to destroy bacteria. The general action of ether consists in a striking postoperative analgesia and an increased leucocytosis.

Gardner (5), experimenting in the research laboratory of St. Thomas's Hospital, London, reported that "favorable results in peritonitis could be obtained by stimulating phagocytosis and thus acting anti-aggressively. (The term aggressin is given to any substance found in the process of bacterial growth which aids the organisms in their attack upon living tissues. This substance, or toxin, acts by inhibiting phagocytosis.) Gardner proved experimentally that ether was markedly anti-

aggressive, i.e., by increasing phagocytosis it diminished the aggressive action of the toxin upon living tissue and prevented further multiplication of bacteria.

Wolff (6), in the *Journal of Experimental Medicine*, reported that she had found ether to be slightly positively chemotactic in concentrations of over 0.1 per cent, when there was an increase of about 50 per cent over the control, in the number of cells adhering.

Both from an experimental and clinical standpoint, one can positively state that ether, while having a certain bactericidal power, should not be used for that purpose as its action is too transitory to be of much value, but that its local use should be solely based on its anti-aggressive properties. By creating a rapid though evanescent hyper-leucocytosis, it aids the natural body defenses.

3. We finally come to the third and last question, i.e., the duration of the stimulant or irritant action. Basing their opinions very largely on the erroneous assumption that ether retained its liquid state in the body cavities, skeptics were—and still are—of the opinion that ether is capable—*per se*—of producing a deep enough destruction of serous surfaces to lead to the formation of permanent adhesions. That such adhesions are formed after the use of antiseptics of slow absorption which leave a residue behind them, is unquestionably true, and their use in closed cavities has almost universally been abandoned by surgeons.

Resinelli (7) quotes the experiments in Italy of Muscatello, Burci, and Marchetti on guinea-pigs. These investigators concluded that, unless the peritoneal serosa is profoundly altered, it has no tendency to form adhesions, even if the adbominal cavity is opened, and that the mere destruction of peritoneal epithelium is not sufficient to produce adhesions. We know that the peritoneum also possesses a high power of digestion, so that false membranes, fibrin plaques, etc., are rendered absorbable.

We have already mentioned the fact that Souligoux had used ether experimentally in the peritoneal cavities of guinea-pigs without noting any ill effects.

In 1914–1915, J. J. Moore—at that time bacteriologist at the College of Physicians and Surgeons of Chicago—undertook, at the writer's suggestion, a series of ether experiments on guinea-pigs. In a fairly large series of cases, he was able to demonstrate a primary stage of hyperæmia, the appearance of fine flocculent adhesions lasting from three to five days, terminating in a *restitutio-ad-integrum*.

Santy (8), of Lyons, France, testing the effect of ether on the peritoneal cavities of rabbits, reported his findings as follows:

First 24 hours: Slight congestion of peritoneum.

Third day: Marked congestion of peritoneum.

Fourth day: Lessened congestion; capillary dilatation.

Twelfth day: Macroscopically normal peritoneum; microscopically the omentum is slightly thickened.

Twenty-fifth day: Normal peritoneum.

Aglae Sklass (9), also of Lyons, arrived at the same conclusions.

Adverse experimental reports are those of Terraca (10) and of Cubbins and Abt (11). The former states that the injection of ether in 1:1000 of body-weight quantity caused death of the animal in a few minutes if the pleural cavity remained closed, but that the same quantity of ether was well tolerated if the ether vapor was allowed to escape through a fistula. The injection of 1:1000 of body weight of ether into the animal's peritoneal cavity was well tolerated, but he found hæmorrhagic infarcts and firm adhesions. Cubbins and Abt, using one ounce of ether to a 15-pound dog, conclude that: "It (ether) is not nearly so violent an irritant as a 3½ per cent solution of tincture of iodine. When the peritoneum is manipulated with the gloved hands and gauze sponges, and ether applied, there is not much more trauma than one would expect with manipulation alone, but the ether did seem to have a very marked effect in reducing the resistance of the peritoneum to infection. From these experiments we cannot see the value of the use of ether in the peritoneal cavity, and it is our candid opinion that individuals in whom it is used will recover in spite of it and not because of it."

From a close study of the pictures of canine peritonea which illustrate the latter article, one is forced to the conclusion that firm adhesions were the invariable rule in that particular laboratory, whether antiseptics were used or not! One must, however, remember that, at the time these experiments were being carried out, the quantity of ether used, per body weight, was entirely too large. No effort was made to control the leucocyte curve before and after ether lavage of the peritoneum, and the simultaneous injection of pyogenic bacteria and ether in a normal peritoneum does not—by any stretch of the imagination—conform to clinical conditions in the human.

Reviewing a clinical experience extending over a period of 10 years, including extensive war work overseas in addition to charity and private work in Chicago, no case of post-operative adhesions, revealed symptomatically or necessitating a secondary laparotomy, has come to our notice, and we are firmly convinced that ether vapor, introduced in proper quantity in any of the serous body cavities, is incapable, *per se*, of producing firm and permanent adhesions.

During the World War, practically all French, some Belgian and Italian, and a few British surgeons used ether in the primary local treatment of wounds. The conclusions adopted by the Inter-Allied Surgical Conference held in 1917 repeatedly advocated the local use of ether in the treatment of wounds, especially those involving serous cavities. Since 1919, an ever increasing number of favorable reports have appeared in the surgical publications of European countries. There is even quite an extensive literature on the subject of the treatment of pertussis by means of intramuscular injections of ether.

In America, many industrial surgeons—especially ex-army surgeons—are using ether in joint and other infections. J. J. Moorhead, of New York (12), writing on the subject of purulent synovitis of the knee, states: "The injection of 2 to 4 drachms of ether after each aspiration will be of decided benefit. I have used ether injections with great satisfaction since the method was called to my notice by Major Lardennois, then consultant of the French 5th Army Corps with which I was serving." Moorhead, (13) while Commanding Officer of Evacuation Hospital No. 10, A.E.F., used ether in thoracic and gas-gangrene cases as did also the French surgeons Tuffier, Souligoux, Lardennois, the late Morestin, and many others. In a very recent careful review of the final reports of all Mobile and Evacuation Hospitals of the A.E.F. in France, one was struck with the almost uniform praise given to the use of ether lavage in wound infections. One report states: "The method which gave universal satisfaction to the patient and surgeon was the thorough cleansing by shaving and ether spray of the entire surroundings of the wound and the cleansing of the wound itself by ether spray and ether-soaked sponges. After a day or so, the wound was strapped with adhesive in such a manner as to cover it almost, if not quite entirely, and relieve all tension upon its edges. This dressing was allowed to remain 48 to 72 hours. On its removal, a large quantity of secretion was generally found which was gently wiped away and the ether toilet again performed. Absolutely no other solution was allowed to touch the wound. In this manner large denuded surfaces of months' duration, which had resisted other methods of treatment, were entirely healed over in a few days."

A still more complete army report on ether includes the following orders for the surgical units: "After débridement of the wound, the latter shall be douched with ether and drained—if necessary—with gauze moistened with ether. A wet dressing of ether should then be applied and a copious dressing of non-absorbant cotton placed over it. All joint wounds and compound fractures should be irrigated with ether and dressed with ether-soaked gauze dressings."

One could go on quoting numerous similar reports; all tend to prove that the advantages of ether lavage were recognized by a majority of the army surgeons whose opportunities permitted them to follow this procedure.

Neudorfer (14), in 1921, reported 22 cases of peritonitis treated by ether lavage, with 17 recoveries. Of the five deaths, one from pneumonia and one from a phlegmon of the floor of the mouth, have no connection with

the peritonitis. The author himself states that he admits only one failure in his series.

Letzko (15) reports that he finds ether lavage very beneficial. Even Russian surgeons have tried the method and Mandelstamm (16) reports that he has been able to verify the superior results of ether lavage. Cheinisse (17) published in the *Presse médicale* a collective review on the tretament of pertussis by means of intramuscular injections of ether. Genoese (18), d'Aroma (19), and others have written on the same subject.

TECHNIQUE OF ETHER LAVAGE

Ether is not a panacea; it will not prevent postoperative shock, hæmorrhage, or adhesions caused by bungling surgery and will not save patients who are too toxic to respond to any kind of stimulation. We firmly believe on the other hand that ether lavage is a local and general adjuvant to nature's combative and reparative forces, i.e., it is an anti-aggressin.

Whenever, from any pelvic or abdominal source of infection, free or localized pus is found, the organ or organs involved are first of all treated according to indications. Pus is wiped or preferably suctioned without breaking down protective barriers—if any exist—and the surgeon begins to close the peritoneum. While doing this, one ounce of ether is poured into the pelvic or peritoneal cavity, without attempting to wash or otherwise disturb the normal relation of any of the abdomino-pelvic organs. No swabbing out is done, but the peritoneum is closed as rapidly as possible in order to minimize the loss of ether through evaporation. The anæsthetic is not interrupted.

Drainage, exclusively of the cigarette variety, should be instituted only in cases where it has been impossible to remove all macroscopically necrotic tissue or where a fistula is either present and cannot be closed, or is probably going to occur.

While admitting the fact that present-day indications for drainage have markedly lessened through improvement in technique and an increasing confidence in the protective and reparative forces of the peritoneum and other serous sacs, we are closing, without drainage, pelvic and abdominal incisions which we certainly would drain if ether were omitted from our habitual technique.

We again desire to emphasize the fact that the proper method only requires a pouring in of ether, without washing, sponging, mopping, or otherwise traumatizing serous or synovial tissues. Ether gas, under tension, admirably accomplishes the dissemination which the original advocates of the method endeavored to obtain by systematic washing out or lavage of the peritoneal folds and fossæ.

In all cases of pelvic infection, even when free pus is not encountered, ether has been poured into Douglas's pouch in order to aid nature's reparative forces.

Postoperatively, ether is unquestionably beneficial; it tides over the immediate period of restlessness. Patients remain in a somnolent state for several hours.

While it has seemed to us that postoperative pain, nausea, and distention have been lessened since adopting ether lavage, we are not unmindful of the fact that omission of preoperative and postoperative cathartics, minimum handling of tissues, and abolition of tubal or gauze drainage have all contributed toward obtaining an easy and uneventful convalescence.

CONCLUSIONS

1. Ether lavage is not advocated on account of its bactericidal power.

2. In contact with living tissues ether volatilizes in 20 seconds, disseminates rapidly as a vapor and is slowly absorbed without leaving any residue.

3. Experimentally and clinically, ether has been proved to be an anti-aggressin, producing or increasing leucocytosis and therefore aiding nature's defenses against infection.

4. As stated in a previous article (21), when we shall all be aggreed regarding the defensive and not destructive meaning of serous or synovial inflammations (peritonitis, pleuritis, synovitis), and when our technique shall be entirely devoted toward increasing their natural defensive properties, our operative mortality and postoperative sequelæ will be reduced to their normal minimum.

5. We firmly believe that Metchnikoff prophesied truly in one of his lectures saying: "When we shall have a better understanding of the physiological action of phagocytes, our efforts will be directed toward the finding of methods which will enhance the activity of the white blood corpuscles in their fight against bacteria and toward other methods for the preservation of essential body cells from the attacks of phagocytes."

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DEPARTMENT OF TECHNIQUE

THE NEAR NORMAL RESTORATION OF A LIMB AFFLICTED WITH THE DISABLING CONSEQUENCES OF AN OLD POTT'S FRACTURE[1]

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THE difficulty encountered in an endeavor to restore to functional efficiency a crippled ankle joint, the sequence of trauma, is apparent only to one who undertakes the procedure.

It is not so very unusual to see surprisingly good function after fractures of bones essential to joint formation that have been surgically neglected. A Colles' fracture may be cited as an appropriate example. However, deformities are not without significance and they may be of such serious degree that compensatory muscular hypertrophies are inadequate for restoration of the normal physiological balance between the bones and their flexible stays.

A Pott's fracture deformity embodies many of the disappointments that have been unlooked for following the release of the limb from its splinting. The conformation of the structures about the ankle joint may appear anatomically correct; the joint may exhibit a satisfactory mobility; the functional efficiency may appear promising and during the first 6 months encouraging progress usually may be made with walking exercises. This is generally a regular course of action with most fractures of the lower extremities. The time following the first 6 months, however, may find that some fractures of the Pott's type discharged as cured are giving signs of failing efficiency. This evidences itself at first by fatigue and a dull heavy pain in the foot and lower part of the leg.

Later the prescribed exercises are not indulged in with the former resolutions but are generally continued in the hope of overcoming what appears to be only a temporary weakness of the ankle joint. Eventually, it will be noticed that the foot is assuming an everted position as more weight is brought to bear upon it, with the lameness more decided, and the pain when walking more severe.

Though it is apparent to the patient that the condition is not improving, many will continue in this plight for a long time wholly incapacitated to do any work. What is the reason that this class of fractures should give such an unpromising result? Is it the severity of the trauma or is it surgical neglect?

In the first place permit me to define a Pott's fracture. The present teaching is prone to "lump" many of the fractures about the ankle as Pott's, or a modification of Pott's. Such teaching is not conducive to the best interests of those who do not specialize in this branch of surgery, and will show itself in the end-results, the sequence of improper treatment.

A Pott's fracture is always an abduction lesion. It is a definite entity with characteristics that have linked the name of the great St. Bartholomew surgeon with this trauma ever since he gave us his description in 1779.

In simply noting that a Pott's fracture consists of a fracture of the lower end of the fibula not usually higher than 2½ inches, a fracture of either the tip or a greater portion of the internal malleolus, a tearing of the interosseous ligament by the wedge-shaped edge of the partially everted astragalus, and if the force is sufficiently strong a luxation of the lower end of the tibia, it is rather difficult for one not experienced with these fractures to realize how disastrous an end-result can be.

The poor results in the treatment of a Pott's fracture, excluding a wrong diagnosis for which, through the notable increase in our knowledge of details obtained by the use of the roentgen-ray there is no longer any excuse, are not poor because the proper splint is not applied, but they are poor because in all probability there has been a faulty reduction. If the reduction has not been faulty, it is very likely that the proper maintenance of such a reduction during the reparative process has been overlooked.

Another reason for a poor result is the too early release of the foot and leg from its splinting. In

[1]Presented at the meeting of the Southern Surgical Association, Memphis, Tennessee, December 12, 13, and 14, 1922.

this respect a Pott's fracture is unlike any other fracture because the tibio-fibular and interosseous ligaments play a very important rôle in preventing the widening of the mortise within which the astragalus is held.

When the mechanism producing a Pott's fracture is considered, the importance of these ligamentous structures becomes clearly apparent.

In defining the mechanism of this type of fracture we have primarily a fracture of the fibula caused by pressure being brought to bear on the tip. The foot is turned out causing the interosseous ligament to be put on great tension. If this ligament is sufficiently strong to withstand this tension, the break in the fibula will be usually higher up than at the tip.

The next phase is a fracture of the internal malleolus to a greater or less degree. As the force continues and the weight of the leg comes on the astragalus, this tarsal bone in its partially everted position becomes wedged between the tibia and the fibula, bringing disaster to the interosseous ligament.

If the force ceases here a Pott's fracture without serious complications is produced. However, should the force continue, a compounding of the fracture and also a forward luxation of the tibia may result.

It is obvious from an analysis of this mechanism that in a Pott's fracture good restoration of these ligamentous structures is absolutely necessary before walking exercises are permitted. To have this assurance it becomes imperative that this type of fracture be kept confined for a longer period in a properly adducted position than is usually allotted to an ordinary fracture. The objective is a firm ligamentous union and this will require more time than a bony union.

The interosseous ligament harbors the essential lesion and is the most important factor so far as the final result is concerned. If repair of this structure is accurate and firm, the mortise of the ankle joint will be very near normal and the patient will be able to walk square footed, and the foot will be plumb with the leg.

If for some reason or other the interosseous ligament should remain loose or torn, a wedging of the astragalus between the tibio-fibular articulation will take place with the resultant eversion of the foot soon after weight-bearing is permitted.

The increased strain of these exercises upon the internal-lateral ligament will have a tendency greatly to impair the union which is usually fibrous between the fractured internal malleolus and the tibia. This will result in a displacement

Fig. 1 (at left). Old Pott's fracture with characteristic eversion deformity.

Fig. 2. This shoe had been worn for 3 months. The light area on the sole shows where there was no contact in walking.

of the malleolar fragment with more damage to the mortise. It is at this stage that the eversion of the foot becomes pronounced.

When such a condition has once established itself, the eversion will be permanent, continually increasing in degree. Appliances, principally braces, are of little avail and there remains no other way than to treat this condition on an operative basis.

A Pott's fracture accurately diagnosed and properly treated from its incipiency will usually result in satisfactory functional efficiency of the ankle joint. The salient features in this type of fracture are the recognition of a possible anterior luxation of the tibia, its successful reduction when present and its maintenance during the after-treatment. Replacement of the external malleolus as near anatomically correct as is possible is essential, and an accurate apposition of the displaced internal malleolus with the fracture surface of the tibia to form a mortise that will hold the foot plumb with the leg, must be assured. Finally the posterior and lateral splinting, preferably with plaster of Paris, holding the foot in

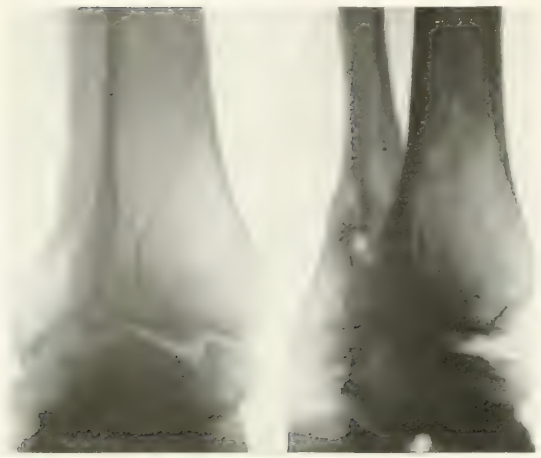

Fig. 3 (at left). Old Pott's fracture. Anteroposterior roentgenogram 10 months after injury. Note healed fracture of fibula about 2 inches above joint with lateral displacement. Note fractured internal malleolus rotated and displaced downward. There is non-union. The astragalus shows marked tilting caused by a damaged mortise. There is strong eversion of the foot. A line drawn along the middle of the tibia would strike the inner border of the astragalus, whereas normally it should fall about the middle of the bone.

Fig. 4. Lateral roentgenogram of same case as in Figure 3. Note rotation and downward displacement of internal malleolus, also lateral displacement with some shortening of fibular malleolus. The tibio-astragaloid articulation shows by the large gap the partial loss of its normal support.

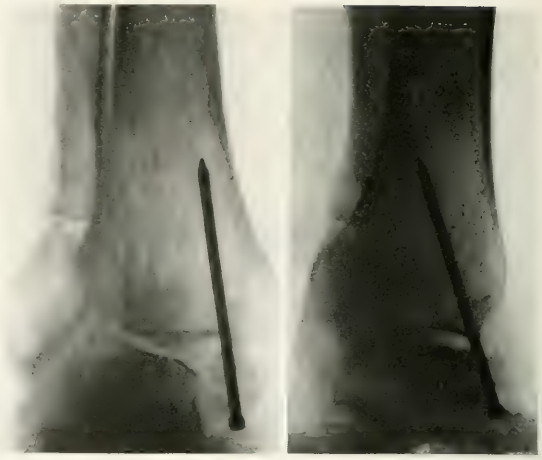

Fig. 5 (at left). Anteroposterior roentgenogram of same case 8 weeks after operation showing internal malleolus held in position by nail. The fibular malleolus shows the loss of substance sustained in correcting the lateral displacement. When the bone ends were brought to an almost normal alignment there was a gap caused by loss of bone to the extent of about half an inch. This gap was bridged with a transplant. Note the filling of the gap by new bone.

Fig. 6. Lateral roentgenogram revealing the tibio-astragaloid articulation more nearly normal than in the anteroposterior view, because the part of the picture showing where the edge of the articular surface of the astragalus had been forced like a wedge between the tibio-fibular articulation is considerably obscured.

flexion on the leg with an associated adduction carried beyond the mid-anatomic line completes the initial procedure. This position is absolutely necessary to secure a perfect contacting of the normally contiguous surfaces of the tibia and fibula, thereby aiding the torn interosseous ligament to regain as much of its normal integrity as is possible, and averting a tibio-fibular diastasis.

When a Pott's fracture with an apparently good result is released from the splints after the usual time necessary for restoration, yet gives evidence of an eversion deformity 6 months later, it is obvious that some of the structures about the ankle joint were either not properly aligned or were inefficiently repaired.

The ankle joint normally is perfect in its ginglymoidal action. Any structural deviations, the result of trauma, will seriously impair its normal movements.

The factors usually contributory to a Pott's eversion deformity are a posterior luxation of the ankle, a united but displaced fibular malleolus, and a non-union, i.e., a fibrous union, of the tibial malleolus. These structural deformities cannot be recognized with any certainty merely by an inspection or a manipulation of the joint.

A roentgenogram will reveal the factors responsible for any faulty relationship, and an exact interpretation becomes imperative when an operation for the correction of the deformity is contemplated.

The operation on an old Pott's fracture with a bad result is a difficult undertaking and should never be hastily considered. It is a painstaking piece of work requiring the closest vigilance in the observance of the aseptic rituals. Perhaps the greatest difficulty encountered is the reduction of an anterior luxation of the tibia on the astragalus. An exostosis on the articular surface of the tibia may prove obstructive to a successful reduction and its maintenance, and may require the use of the chisel. In extreme conditions it may become necessary to resect the anterior portion of the tibia to restore the bone to its normal relationship with the astragalus.

The fractured fibular malleolus may be displaced from its normal site. It must be operatively brought into correct anatomical alignment for the proper support of the astragalus.

This will necessitate refracturing of the bone and a possible rectification of the tibio-fibular articulation to facilitate malleolar restoration. To prevent recurrence of the displacement the fixation of the fibular malleolus to the tibia is secured with one or two nails.

The tibial malleolus may show a mal-union or no union at all, and may have been displaced downward and rotated outward by the pull of the soft parts. It will be necessary to dissect this bone-fragment out of the connective tissue mass and free it with the attached deltoid ligament from adventitious position that contact with the adjacent surface of the tibia may be made possible. Freshening of the broken surfaces will be necessary and their accurate apposition must be secured with a nail driven through the fragment and into the shaft of the tibia. These corrective measures are carried out through two lateral incisions anterior to the malleoli and sufficiently large to facilitate the work.

The operation should be performed under aseptic measures sufficiently convincing to permit wound closure without drainage. A plaster of Paris cast extending from the toes to the knee, exercising care that no pressure is exerted on the external popliteal nerve as it winds around the neck of the fibula, secures the foot in a flexed and adducted position. The cast is split soon after it has hardened and is allowed to remain for 4 weeks. A lighter cast is then substituted for another 4 weeks. After the removal of this cast, baths, massage, and passive motion are assiduously given, and 4 weeks later active weight-bearing is permitted.

The operative results which I have obtained in four patients who were suffering from old Pott's eversion deformity of the foot where the unfitness for work became the compelling cause for operation, were sufficiently successful to obtain from three-fourths to four-fifths normal functional efficiency.

THE SPOT-LIGHT IN SURGERY

By J. G. R. MANWARING, M.D., F.A.C.S., Flint, Michigan

A PROPER lighting is important in any kind of manual work requiring clear visualization, care, and speed. To be most effective the light should be confined to the field of operation itself. The more the room and surroundings are lighted, the less plainly seen is the immediate area under observation.

This is particularly true in working in a recess. The head surgeons have learned this and use an illumination accordingly, but the general surgeons flood the operating room with intense light through skylights or overhead clusters of electric lamps in order to see a small area.

Williard Bartlett adapted the automobile headlight to the operating room in an effort to obtain a proper effect. This apparatus is cumbersome and a dust catcher, flooding the surroundings, including the surgeons, with light and heat. Its mirrors tarnish and still further diffuse the light. As a result of these things many modifications have been made. In addition, it is unnecessarily expensive. It uses a high voltage current (110-220 volts) and is not sharply focused so that it is dropped from the ceiling to intensify the light by its nearness.

A proper light should be sharply focused to a small area a little larger than the field of work; it should be bright; the mirrors should be durable; and the outfit as small and out of the way as possible.

To throw parallel rays of light from a mirror its surface must be parabolic and the source of light must be a point only. In using the ordinary city current the lamp must have a relatively long filament and hence the source of light cannot approximate a point. Such a lamp cannot be focused without much diffuse lighting and an intense light requires its nearness. If the current is lowered in voltage the filament may be reduced in length until it can be made of such a size as to be almost the needed point. With such a bulb and a proper mirror all the light can be thrown out in a well-limited beam, and it will be intense at long distances. This is a fundamental and extremely important principle.

The ordinary automobile spot-light answers the purpose admirably. It requires a current of 6 to 8 volts. To use the city current, a small transformer must be interposed in the circuit. It is adjustable in all directions, the bulbs easily replaced, the light easily focused. The mirrors are protected by the shell and glass in front so that they will last indefinitely. The outfit is easily obtainable of any electrician or surgical supply company and, finally, it is cheap.

In use, the field lighted is warmed, but this is a great advantage to the patient who is exposed and of no annoyance to the surgeon who is not.

Sharply focused portable lamps using dry-cells are now obtainable which are a great help when working in private homes. The ordinary "flash-

Fig. 1. *A*, Well focused flash-light (Eveready spot-light); *B*, ordinary flash-light with divergent rays. No sharp illumination at 3-foot distance; *C*, lantern (Delta) sharply focused; gives brilliant illumination at 10 feet and more.

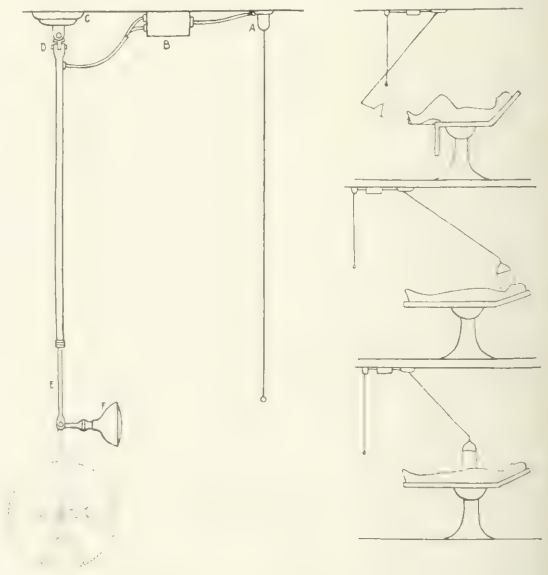

Fig. 2. Ceiling bracket for office use. *A*, Pull-cord switch on feed line; *B*, transformer; *C*, base fastened securely to ceiling; *D*, universal joint; *E*, telescoping extension with range of 20 inches; *F*, small auto search-light hung on hinge joint.

The rest of the figure shows the manner of its use. In the drawing the light is relatively too near the patient.

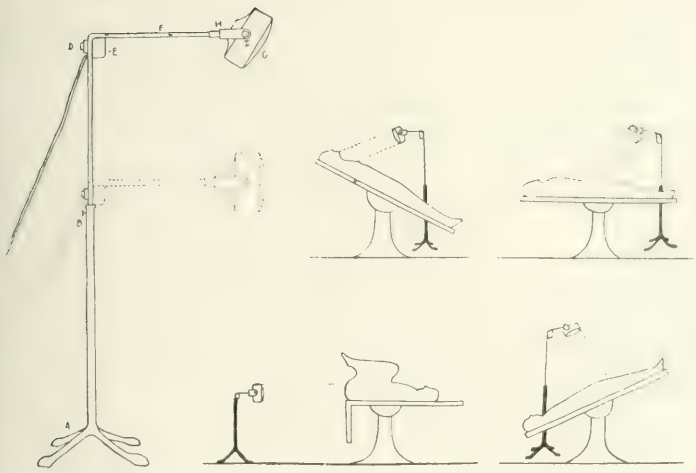

Fig. 3.

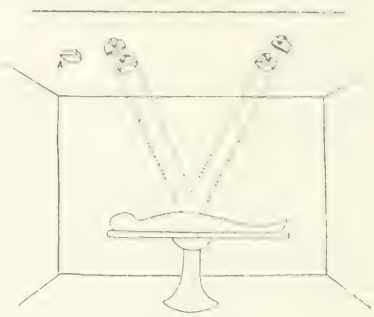

Fig. 4.

Fig. 3. Stand lamp for operating room. *A*, The stand should be heavy, and broad; *B*, adjustment screw by which the supporting arm is raised or lowered within a range of 3 feet; *C*, switch on feed line; *D*, transformer; *E*, extension arm 18 inches long; *F*, automobile search-light (Stewart). This is tilted at *I* and revolved at *H* to any position.

Fig. 4. Operating room equipment of four search-lights (Stewart) mounted directly on ceiling so as to be adjustable in direction. *A*, transformer.

light" is not sharply focused so that it has to be held too near the field for good surgical technique. One type, however, is sharply focused for long range use and has an adjustable focus which makes it very convenient. This may be used several feet away with advantage. It is suitable for emergencies, examinations, etc. For better illumination those of the larger type illustrated are very good. Two of these properly placed give a good illumination of an operation field.

For office work we use the long telescoping, adjustable ceiling bracket with a small, light spot-light. It can be adjusted to any position, it can be obtained in various lengths and it has a multitude of uses. It is fine for testing the eye reflexes (covering the lamp, not the eye), removing foreign bodies from the eye, for throat work, minor operations generally, and for vaginal and rectal illumination. In addition to all this it is a splendid light when used with a head mirror.

For a stand lamp in the operating room the apparatus is mounted on an adjustable stand. This makes a useful lamp for assistance in operating in the recesses of the body.

It has been suggested that the outfit can be mounted on a suitable bracket and used in one of the numerous sockets of the modern operating table.

For use as a ceiling light in the operating room four or more of these lamps can be mounted directly on the ceiling, focused to an area about 1 foot or more in diameter, and directed to a common center. The operating table is shifted if necessary to bring the field in this lighted area.

The lights are placed far enough apart so that shadows are practically eliminated. The focused rays of the different lamps should meet at an angle of 30° to 45°. These lights can be used to advantage even in the daytime.

Inasmuch as the light is so sharply limited it is necessary to have other ordinary electric lights to illuminate the room, the instrument tables, etc. One who uses such lamps for a time is well satisfied without a large skylight in the operating room.

Certain precautions are important in using these lamps on city currents. The switch control must be on the feed line before the transformer is reached. The transformer must be of suitable capacity to deliver the proper voltage. For one 32 candle power bulb requiring 6 to 8 volts, a transformer of 50 watts capacity is used.

For four ceiling lamps of similar character, one heavy duty transformer is used, reducing the current 6 to 8 volts. The lamps are wired in multiple and not in series. If one bulb burns out the rest will still function. Such a transformer should not be far from the lamps.

In using the single lamp a little experience is needed to find where it is placed to best advantage. For mastoid, vaginal, rectal operations, etc.,

the lamp should direct its rays over the operator's left shoulder (if right-handed). In goiter, deep pelvic and deep epigastric operations, the rays should light the field from a line in the center of the table as indicated in the drawings.

While we have not used such an apparatus, a head-light could be made upon the same principle which would be much better than any with which we are now familiar. It should be small, with an aluminum shell, a true parabolic mirror and filled with a suitable bulb. It would give a much better field than the usual type.

QUILTING THE REMAINING LOBE AS AN EMERGENCY PROCEDURE DURING THYROIDECTOMY FOR EXOPHTHALMIC GOITER

By HARRY G. SLOAN, M.D., F.A.C.S., Cleveland, Ohio

IT happens, in the experience of everyone operating on goiter of the exophthalmic type, that the reaction of the patient during operation exceeds the limits anticipated by the surgeon. This happens, in spite of the painstaking novocaine block of the operative field and gland. We have found this to be especially true in the instance of young, blond women. The clinical judgment of the operating surgeon must necessarily be the court of last appeal in deciding the type of operation and the proper time to do it. In spite of all the help he may bring to his assistance in coming to his decision, he finds himself every now and then to have decided not wisely. The reactions of the vascular system and respiratory rate give the only means of judgment, during operation, of the immediate condition of the patient and influence us in making our estimate of the severity of the postoperative reaction that reaches its height 36 hours later. When one partial lobectomy is completed the operator may feel that it is essential for the patient's safety to stop the operation. Three courses are open:

1. To pack the wound open. Here a secondary closure is necessary and a large proportion of the cases develop infection with its attendant prolonged drainage.

2. Simply to close the wound. It is more than likely that a second partial lobectomy will then be necessary to bring about a cure.

3. To quilt the remaining lobe and close. Three chromic gut sutures are placed so as to constrict the remaining gland in its middle, upper and lower thirds at right angles to its long axis. The gland is gently lifted forward and laterally and the encircling sutures placed by means of a slender curved needle, special attention being paid not to include the recurrent nerve. The sutures are tied quite snugly. The wound is then closed. This emergency procedure has stood us in good stead for 3 years and has so far resulted in a cure in each instance.

There is an additional essential procedure which we have stressed in our expectation of cure in exophthalmic goiter; namely, eradication of the infectious focus which we feel is the contributing factor to the activity of the disease. In 9 out of 10 instances, the tonsils are to blame; later in life it may be teeth, gums, sinuses, or some abdominal focus.

Severe cases of exophthalmic goiter are rarely cured by the removal of one lobe, and it is with this fact in view that we have aimed to put out of action, at one sitting, more gland tissue by our quilting procedure. The extra insult to the patient is minimal. The quilted lobe shrinks down so that it is often difficult to tell a year later which lobe was removed and which quilted. The practice has a limited application, but is well worth while because without further operation there is a likelihood of obtaining a cure.

EDITORIALS

SURGERY, GYNECOLOGY AND OBSTETRICS

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JULY, 1923

ACUTE INTESTINAL OBSTRUCTION

THERE is much current discussion on the subject of acute intestinal obstruction. Increasing attention is being focused on the methods of making an early and accurate diagnosis, the cause of death, and the treatment. These factors are of vital importance, since the mortality rate, as shown by numerous contributions to the literature, is entirely too high. Facts gleaned from experimental laboratories and from clinical observations should be correlated in order that we may make a united effort in combating the fearful existent mortality.

Acute intestinal obstruction would be a relatively benign condition were it always diagnosed immediately and prompt surgical intervention instituted. The mortality is in direct proportion to the time elapsing before operation is performed. In few conditions are the results of diagnostic error and delay so tragic.

In the last decade very little has been contributed concerning the symptoms and signs of this disease. Some contributions of great worth, however, have been made emphasizing the value of the X-ray, with or without barium in the intestinal canal, as a diagnostic factor. This examination may be made either with the fluoroscope or by a study of the X-ray plates. If the point of obstruction is in the large bowel, the haustral markings localize it immediately without the use of barium; but if in the small bowel, it is much more difficult to locate the obstruction. Barium administered immediately following a thorough gastric lavage, however, will in many instances be carried at once to the point of obstruction and enough of the substance will remain in position for a sufficient period of time to locate it accurately with either the fluoroscope or X-ray plate. This will enable us to perform many of these operations under local anæsthesia. It will save the immensely valuable minutes so frequently lost seeking the point of obstruction.

It is well to emphasize, also, the fact that the absence of gurgling, as determined by the stethoscope, can neither rule out a mechanical obstruction nor be relied upon as positive evidence of paralytic ileus. We have observed several instances of acute obstruction where very careful examination with the stethoscope at repeated intervals failed to reveal the slightest sound, causing dangerous delay in performing the operation.

Many theories have been advanced endeavoring to explain the cause of death. Among the factors emphasized in these theories are proteose intoxication, bacterial poisons, injury to the intestinal mucosa, and dehydration. No single theory seems to satisfy all conditions, due to the inter-relation of these etiological factors. Among the impor-

tant experimental observations is the demonstration of the action of the proteolytic intestinal bacteria in producing poisonous products.

The basis for the accepted modes of treatment rests on certain fundamental facts derived from clinical experience and laboratory investigation. It is a well-known fact, for example, that a complete strangulation of the small bowel causes extreme symptoms and marked shock, the severity of the symptoms and rapidity of the lethal outcome varying with the amount of bowel strangulated. Another striking clinical feature is the early and intense thirst. It follows that two important procedures to be carried out are the immediate relief of the obstruction and the administration of a sufficient quantity of fluids. Drainage of the toxic bowel contents is another factor of importance, especially in desperate cases where the cause of the obstruction cannot be quickly located.

In combating the toxæmia and dehydration, the copious administration of liquids by the subcutaneous, intravenous, and rectal routes is a life-saving measure. Free diuresis is essential in eliminating the poisonous substances from the blood stream. Ringer's solution is preferred for this purpose, as its diuretic action is superior to that of normal salt solution. These poisonous substances are absorbed from the bowel, it being freely admitted that the contents of the bowel above an obstruction or in an obstructed loop, are toxic. Many thousands of cases are on record, however, as being completely relieved by the mere removal of the obstruction. This seems to indicate that the bowel distal to an obstruction does not completely absorb the toxic products which are emptied into it after the obstruction is freed. It has been shown that the administration of large quantities of lactose will largely eliminate from the intestinal flora the proteolytic bacteria the action of which forms certain poisonous substances in the bowel. Though the administration of lactose by mouth or duodenal tube following operations for intestinal obstruction may not be practical, due to persistent vomiting, its use as a prophylactic measure might seem rational following operations for inflammatory intra-abdominal lesions where the subsequent occurrence of a paralytic ileus is not unlikely.

Before any operative procedure is undertaken, gastric lavage should be instituted until the distended stomach and bowels are fairly empty. This facilitates the ease of operation and removes much of the toxic material. Keep the patient warm. Give fluids freely and transfuse those severely ill. These are universally recognized essentials.

Relative to operative treatment, the surgeon must be careful not to be carried away by the belief that any one course of procedure is wholly right or wholly wrong. At the present time there is a marked divergence of opinion as regards the value and location of an enterostomy. Some hold that the enterostomy should be performed high in the jejunum; some prefer it at the obstruction; some perform it anywhere above the obstruction; while others favor freeing the obstruction in all cases, instituting any other necessary operative procedure at the same time.

Enterostomy is performed by many at the present time because apparently hopeless cases have recovered following its use. There are, however, some dangers in this procedure and we do not believe it alone is sufficient in all cases. It must not be supposed that an enterostomy will sidetrack all material from the bowel below, because many of us have seen fæces collect in the rectum and sigmoid below a colostomy, where the two stomata are side by side. Since this can occur with such complete severance, is it not much more

likely that bowel contents will pass beyond the enterostomy? An enterostomy does not entirely obviate the possibility of the constricting agent causing gangrene and perforation, with peritonitis or abscess at the constricted point. Furthermore, the operation for the closure of a fistula is not a simple procedure. Particularly dangerous and difficult are colon fistulæ in an emaciated patient where the fistulous tract is short. For these reasons we should not be carried away with the idea that fistulæ must always be made in obstructions of the bowel; careful judgment must be used. If the patient is in fair condition, one should relieve the obstruction and, when necessary, resect, if it can be speedily done, using a deep-lying Witzel fistula above to avoid the temporary paralysis at the point of resection. If the patient is of the almost hopeless type so frequently seen, by all means make a fistula at the most convenient point, preferably one by the Witzel method, or any other that will make a long tract, as fistulæ close in inverse ratio to their length; the longer the fistula the quicker the closure.

William R. Cubbins.

THE GRADED OPERATION IN THORACIC SURGERY

When one has witnessed death following a brief illness, a relatively trifling accident or a minor operative procedure, even so trivial as a needle puncture, one is inclined to feel that life may indeed hang by a thread. Yet he who studies conditions of disease has occasion frequently to marvel at the extraordinary resistance of the human organism to infection, and its adaptability to structural changes of sufficiently gradual onset for the defensive or adaptive mechanism to act. The principle involved in the gradation or division of a surgical procedure into stages is based fundamentally on this adaptability. The graded operation in all major surgical conditions to which it has been applicable has yielded a minimum mortality and has extended operability to otherwise hopeless conditions.

In abdominal surgery the graded operation has been of great value in lessening surgical shock and in limiting the spread of infection, as for example in the Mikulicz operation for resection of the bowel. In resection of the stomach and rectum, and in operations for acute infections and intestinal obstruction, the indications for graded operation are similarly based on lessened shock and limitation of infection. Ligations and single lobectomy for hyperthyroidism and suprapubic cystostomy preliminary to prostatectomy are other familiar examples.

In major operations on the thorax there are also hazards due to infection and shock. Furthermore, the pleural cavity contains no such mechanism for defense against infection as the omentum, and many of the patients are in such relatively poor condition that serious postoperative shock is prone to follow an extensive single-stage operation. Another and even more important indication for the graded operation in thoracic surgery is the possibility of serious embarrassment of respiration and circulation. The function of the gastro-intestinal tract may be suspended for days, but the efficient function of the heart and lungs, two of the three organs constituting the "tripod of life," cannot be seriously interfered with, even momentarily, without endangering life.

A two-stage operation affords the greatest safeguard against spreading infection in the drainage of pulmonary and subdiaphragmatic abscess. The chance for fatal mediastinal infection following resection of diverticula of the cervical œsophagus is similarly lessened. Shock can be avoided in the most extensive

extrapleural thoracoplasties for tuberculosis and bronchiectasis by dividing the procedure into as many stages as the condition of the patient may demand. Such gradual collapse also allows the intrathoracic organs to accommodate themselves by degrees to changes in intrathoracic pressure, and lessens the tendency to retention of the septic purulent pulmonary secretions. Moreover, the patients do not object if the whole procedure is rendered relatively painless, as it may be, without additional risk, by careful local and regional anæsthesia combined with nitrous oxide and oxygen analgesia, and by alcohol injection into the nerve trunks to minimize postoperative pain. In chronic empyema, particularly in cases of long standing, and in those in which the cavities are large, shock and serious postoperative sepsis are largely avoided and the postoperative mortality greatly reduced if preliminary drainage and irrigation are followed by graded thoracoplasty. In extensive resection of a tumor of the chest wall in lobectomy for pulmonary suppuration, and in extensive resection of the thoracic œsophagus for carcinoma, shock, infection or embarrassment of respiration and circulation, or as usually is the case, all these factors combined, have resulted in an almost prohibitive mortality. Substantial progress in such extraordinary difficult fields seems hardly possible until the operative hazards have been reduced to a minimum. The graded operation is proving a means to this end. C. A. Hedblom.

MASTER SURGEONS OF AMERICA

JAMES BELL

THE death of James Bell on April 11, 1911, was no less a surprise than a shock to the large circle of his friends and admirers throughout Canada and the United States; a shock naturally, but a surprise also, in that the cause of his death was appendicitis, a malady the treatment of which he had been one of the earliest in Canada to establish on sure and safe foundations. It was one of those retrocæcal and gangrenous forms causing acute toxæmia, without clear localizing signs, which kill within a few days. His illness indeed lasted only 6 days. Of its kind it was a tragedy. He had been in perfect health, and, though no longer young (he was in his fifty-ninth year), he could still look forward to not a few years of useful work. His unusual skill as an operator was unimpaired, and his judgment, always sound and now ripened by great experience, was at its height. His reputation was no small one on this continent, and was still growing. Always quiet, unobtrusive, and essentially modest, he was nevertheless full of a clinical wisdom which made all that he wrote or said upon surgical subjects immediately attractive and arresting in the minds of the thoughtful. Few were his words but clear his vision. In diagnosis he was quick, accurate, always steady, and frequently brilliant; and this through a certain gift of intuition, meaning thereby that he seized immediately on the essential, and refused to be diverted by the unessential. On the therapeutic side, he was slow to operate but quick in operating; and, the operation once begun, his judgment in determining what to do and what not to do was extraordinarily sound. His technique, at a time when technique was not so carefully considered as in these latter days,—not considered, let us say, the be-all and end-all of surgery, was almost flawless; and his results in wound healing equalled those of the present day.

In person he was largely built, athletic, and had the fair hair, the ruddy cheeks, and the blue eyes of the North man. A noted boxer in his youth, and a rider to hounds in his middle years, he retained a large measure of his great physical endurance to the end of his life.

In character, James Bell was distinguished particularly by a straightforward honesty, without, however, anything of the simple in it, which went at once to the heart of a matter, scientific or other, and brooked no devious road. "Bell's sniff" was a thing widely known. It signified disagreement, and even a certain impatience, not often amounting to contempt (for he was on the whole inclined

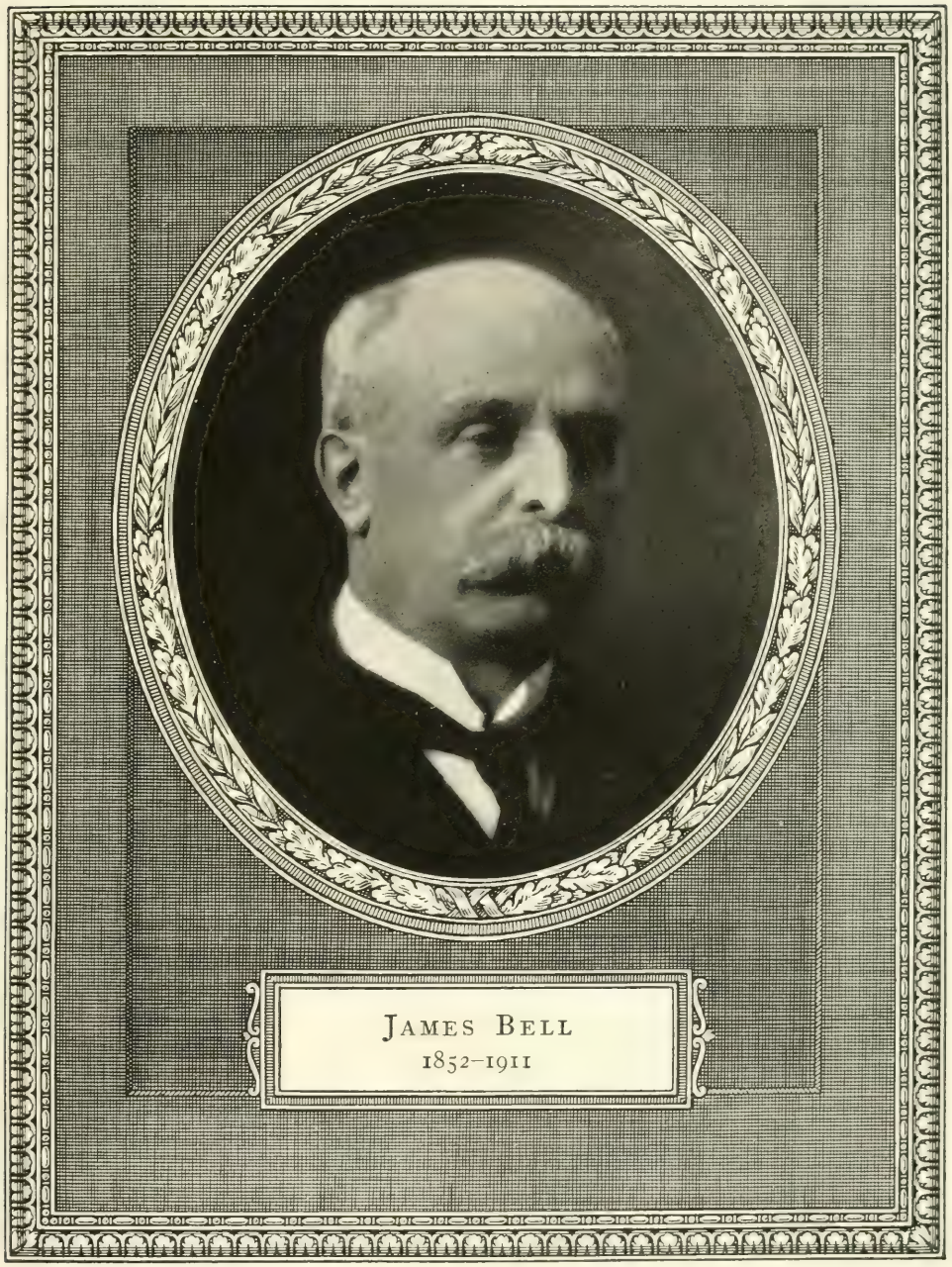
to be tolerant and generous toward the opinions of others), with a view or an action that seemed to him not quite straight or worthy. And his sniff was often followed by a remark so concise, so apposite, and so pregnant that it lodged in the hearer's memory and became a "mot,"—a thing to be quoted.

It was that same habit of straightforward and incisive outlook, which made him the excellent diagnostician that he was. His diagnoses were of prose rather than of poetry; they ran along the lines of sober probability rather than those of imaginative possibility; and the findings at operation often left the imaginative junior somewhat discomfited. That indeed was the best part of his training of the house surgeon, a training which in Bell's eyes aimed at two things: to make of the house man a good surgical pathologist and a precise observer and recorder. Beyond that it hardly proposed to go. And in that insufficiency lay perhaps the one defect in Bell's life as a surgical chief.

In his personal relations he was courteous to all, the friend of many, the beloved of a few. There are those whose facile popularity embraces a large part of their own world, and there are those who maintain a certain reserve toward the crowd but save a deep affection for the few. Of the latter was James Bell; and of such it may be said that their value to the world, whether as friends, as workers, as teachers, or as exemplars generally, is perhaps the greater for these qualities.

Dr. Bell was born in North Gower, Carlton County, Ontario, on October 10, 1852. Brought up on a farm, he never lost his love of the land and the things of the land; his love of horses especially remained strong throughout his life. He owned a small farm a few miles outside of Montreal, and thoroughbreds were his hobby. One can easily imagine him living another score of years, and firmly, to the very end, showing motor car salesmen to the door within a minute of their appearance.

In the year 1874 he was entered as a student in the McGill Medical School, and was graduated in 1877, winning the Holmes gold medal. He then entered the Montreal General Hospital as house surgeon, and was shortly made medical superintendent, in which capacity he served for 8 years. In 1885 Montreal was visited by a serious smallpox epidemic. At that time such cases were still treated in the hospital, and one of the first articles published by Dr. Bell was upon his experience with this disease. In this year also he accompanied General Middleton to the West, on the Riel Rebellion Expedition; did active duty in the field as surgeon major in charge of the hospital corps, and was mentioned in despatches. In 1886 he was appointed one of the attending surgeons of the Montreal General Hospital, and the next 8 years saw many articles from his pen, mostly in the form of interesting case reports upon the subjects which were then considered new, such as appendicitis, the Thiersch method of skin grafting, the suture of the fractured patella, urethral fever, kidney tumors, gastro-enterostomy, perforated



JAMES BELL
1852–1911

typhoid ulcers, the Hartley-Krause removal of the gasserian ganglion, and others. Most of these papers were published in the *Montreal Medical Journal*.

In 1888 he was made associate professor of surgery in the Medical School of McGill University.

In January, 1894, the Royal Victoria Hospital was opened. Built and endowed through the generosity of two famous Canadian citizens, Sir Donald Smith (later Lord Strathcona) and Sir George Stephen (Lord Mount Stephen), and situated on the slopes of Mount Royal commanding a most beautiful view over the city and the River St. Lawrence, it stood out, from the first, as one of the most attractive hospitals on this continent. The chiefship of the surgical department was confided to the late Sir Thomas Roddick, but within a year Sir Thomas retired and was succeeded by Dr. Bell, who at the same time was made professor of clinical surgery. These positions he held until his death.

The opportunity was a great one. Indeed, one might see no other on this continent comparable with it, save at The Johns Hopkins. It was the opportunity, as sole chief of a large surgical clinic, to found a real school of surgery.

In these latter days, when the waters of medical education are being so strongly stirred by winds of discussion, it may not be amiss to relate Bell's plan for the training of the internes of his service. That plan contemplated, briefly, a graded 4 years' course, consisting of a first year in surgical pathology and the outdoor, 2 years of case reporting in the wards, and a final year as resident surgeon. Followed out, it meant the development of a real training school for young surgeons. And this was in 1894, when nowhere else on this continent, if I am not mistaken, save under Professor Halsted at The Johns Hopkins, was there to be seen anything approaching it in ambition and bold design. The result was that his men left the hospital well trained in surgical pathology, in thorough case reporting, in diagnosis and prognosis, and with a reasonably good experience in the mechanics of surgery.

The two medical schools of The Johns Hopkins and McGill were much alike, save in the trifling matter of worldly goods. The Edinburgh tradition in teaching obtained at both places. In each there prevailed the system of clinical clerkships and dresserships, with free access to wards and patients allowed, nay, imposed upon the students,—a system which was conspicuously absent in American schools at this period, when University hospitals were almost unknown. A close bond of union lay in Osler, who had gone to The Hopkins from McGill by way of Philadelphia. Pathology was considered to be the proper groundwork for a scientific surgeon. This attitude toward the training of the young surgeon was shared by Dr. Halsted and Dr. Bell, and the two men in scientific outlook, in ambition, in methods of teaching, and in a recognition of the value of laboratory work, were much alike, although the building of the Hunterian Laboratory gave Baltimore a great advantage. The school of young surgeons which was developed

at The Johns Hopkins during the last 25 years, under Professor Halsted, as the result of a conscious and studied policy of generosity and stimulation, has been the admiration of the medical world, an admiration which is cordially shared by the McGill school.

As to Dr. Bell's literary output, one may merely say that, from 1888 to the time of his death, no year passed that did not see one or more articles from his pen; and his range was very wide. While practically all of these were clinical articles the pathological side was never neglected.

He was possessed, moreover, of an excellent style in the use of English,—a style without ornament, it is true, yet graphic, and withal concise. His articles were never long, but they contained much. "Hard writing makes easy reading," and any paper of Bell's read easily. An earnest and constant student, he was always abreast of the times, and occasionally made, on the basis of his reading, a diagnosis that astonished those who worked under him. Take as an instance the case of a young girl in the clinic, who was found to have a large movable tumor in the epigastrium. His diagnosis of hair ball in the stomach, made almost in a moment, and verified by operation, was the first instance in a series of some twenty recorded cases in which the diagnosis had been made before operation. Again, at a time in the first years of the century, when actinomycosis on its clinical side was but little known in this country, Bell published (1905) a series of 13 cases involving various parts of the body. His experience in the radical operation for laryngeal cancer was unusual, and in 1909 he read a valuable paper on this subject before the American Surgical Association, giving his results in twelve laryngectomies and three thyrotomies. Nor were his judgment and his progressiveness evidenced only in doing the newer things in surgery; they were also occasionally shown in his not doing them. Upon one occasion he jocularly remarked to the writer that he expected before long to earn the distinction of being the only man on this continent who had not done an orchidectomy for hypertrophy of the prostate. He was also the first on this side of the water, if I am not mistaken, to drain the ventricles into the subdural space in cases of internal hydrocephalus, an operation which at the time (1897) seemed to have a sound physiological basis in Leonard Hill's work. Though we have since learned that the idea is physiologically erroneous, the fact nevertheless illustrated Dr. Bell's keenness in the direction of scientific surgery.

That keenness he never lost. And if one were to estimate his value to the world, or to that part of it of which he was the center, one would be inclined to say that it lay above all in the influence which his keenness, his industry, his honesty, and his progressive conservatism exercised upon those who worked with him and under him. A man's immortality lies in what he bequeaths of his own spirit to the younger generation. In this sense the memory of James Bell achieves permanency even more than through his published work. EDWARD ARCHIBALD.

TRANSACTIONS OF SOCIETIES

CHICAGO GYNECOLOGICAL SOCIETY

Regular Meeting Held January 19, 1923, Dr. Rudolph W. Holmes, Presiding

KNOTS OF THE UMBILICAL CORD; DERMOIDS IN PREGNANCY

Dr. Rudolph W. Holmes: It has happened twice in my life that I have lost a baby from knots in the cord, and I have seen perhaps a half dozen cases. This morning I delivered a baby with two true knots in the cord, the baby being born alive.

A recent writer stated that dermoids in pregnancy were rather rare. I cannot believe that because I have had four dermoids now. This specimen comes from a girl, a primipara, and was in the pelvis and prevented the baby from descending. A cæsarean section was done and the baby removed. The girl has a cystic ovary but we left it because it was soft and was evidently not a dermoid. She is 22 years old.

Dr. N. S. Heaney: I would like to know whether the ovary was incised to see if there was anything of a dermoid nature.

Dr. Holmes, closing: The mass was soft and not large and she was so young we thought it was best to leave it alone.

MASSIVE COLLAPSE OF THE LUNG

Dr. Joseph L. Baer: I recently had a rather rare accident complicating pregnancy. The patient was a primipara, 26 years of age, whom I saw in mid-pregnancy. She than had a tumor growing into the left broad ligament which was so large that it completely blocked three-quarters of the inlet, reaching into the true pelvis below the level of the ischial spine, extending into the abdomen about 8 centimeters above the symphysis and displacing the pregnant uterus to the right and above the umbilicus. I let her go to full term and did a cæsarean, making a rather high incision. The operation was entirely uneventful except for a rather brisk post-partum hæmorrhage, the uterus contracting very slowly and poorly. The empty corpus sat on top of the immense fibroid. The patient went to bed with rather a rapid pulse (130) but otherwise in good condition. For 24 hours she did fairly well except that she had a slight cough and was rather troubled with mucus in the throat. Forty-eight hours later the pulse became very rapid (168), she became pale, with cyanotic nails and showed some dyspnœa, but she did not complain. There was no evidence of hæmorrhage, embolus, acute cardiac, or gastric dilatation. Necrosis of the fibroid due to disturbed circulation following labor was considered. Moist râles appeared at both bases that afternoon. Temperature 101, pulse 168, white blood cells, 23,000. Tentative diagnosis, beginning pneumonia.

The following day, 4 days after delivery, Dr. J. C. Friedman made a diagnosis of collapse of the entire right lung. An X-ray picture was taken at that time, another 2 days later, and a third 2 weeks afterward. As you can see, the right chest contains no air. The diaphragm level is very high. The heart is displaced so far to the right that at first we thought we were looking at the film reversed. Within 24 hours of the time this picture was taken the lung showed aeration and within 2 weeks it was restored to complete health. (Figs. 1, 2 and 3.)

The first writer who gave any systematic account of massive collapse of the lung was Pasteur, who, in 1914, described massive collapse following all sorts of operations. The most recent work has been done by John Rose Bradford. Certainly obstruction of the bronchus is the easy and simple explanation of the collapse of the lung. This patient had one vomiting spell on the table but having had nothing to eat there was nothing to aspirate. Bradford believes that the most likely etiology is a complete immobility of the side that is to be affected, the immobilization being due either to pain or some extraneous factor. With complete immobilization there results a secondary collapse of the lung on that side.

Surgeons in the war had a large experience with this subject. They found, for example, that a slight injury of the chest wall, non penetrating, could produce collapse either on the injured side or on the opposite side, the collapse being partial or complete.

CEREBRAL EMBOLUS NINE DAYS AFTER LABOR

Dr. W. M. Thompson: I want to report a case of cerebral embolus 9 days after labor. The patient was 24 years old and this was her first baby. She had had an uneventful history until 2 weeks before labor when she began to have a great deal of œdema of the lower extremities. A large amount of albumin with no casts in the urine led us to believe that it was pressure œdema. She went into labor and was easily delivered with low forceps at 1:45 p.m. At 3 o'clock her temperature was 100.4° F., her pulse had risen from 78 to 104, and the respiration was 22.

Fig. 1. Massive collapse entire right lung four days after cæsarean section. Note the absence of air in right chest. Displacement of heart to right. Elevation of right diaphragm.

Fig. 2. Same, 6 days after operation. Beginning aeration of right lung. Heart returning toward left, shown by relation to skeleton and decreased distance from apex to left chest wall.

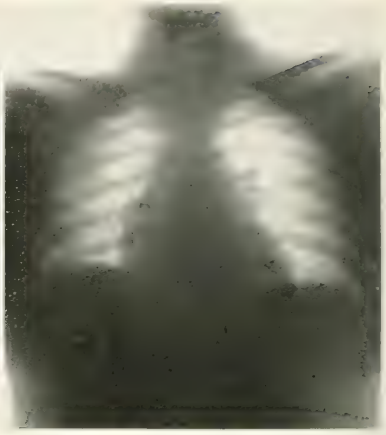


Fig. 3. Same, 2 weeks after operation. Note the almost complete aeration of right lung. Right heart still somewhat dilated.
(Dr. Baer's case.)

In 3 hours her temperature was normal and continued so. On the ninth day, December 21, 1922, I saw her at 10:30 a.m. At 11 a.m. I was called by the interne and told that the patient was in collapse. When I arrived I found these symptoms: The patient was unconscious, the face pale, the breathing sterterous, the eyes open, pupils deviated to the right, the body was flaccid. Within 3 hours she became partially conscious and could answer some questions.

The hemiplegia involved the whole of the left side. In the last few days there has been a noticeable improvement in the left leg both in the flexors and extensors and in the flexors of the left arm. Unless there was some abnormality of the heart, either a patent foramen ovale or a defective ventricular septum, this clot could not have come from the pelvis. The fact that none of the examining physicians have detected any abnormality in the heart sounds and the history of acute inflammatory rheumatism in childhood led me to believe that this focus came from the endocardium. Pulmonary embolism following childbirth is not uncommon but this cerebral embolism 9 days postpartum is, I believe, very uncommon.

Dr. Emil Ries: If a blood clot travels into the lung and disintegrates into small particles there, these particles could pass through the lung only if of the size of the very smallest capillaries of the lung. That size would hardly suffice for an embolus.

SPONTANEOUS VERSION FROM CEPHALIC TO BREECH PRESENTATION IN A PRIMIPARA

Dr. Irving F. Stein: I desire to place on record an obstetrical observation. A primipara, 34 to 36 weeks' pregnant, experienced rupture of the membranes during the night of December 29. She came to the hospital on the 30th, not in labor. Examination revealed a cephalic presentation, the head being at the inlet and movable. An X-ray taken at that time checked the findings on external examination. The patient was kept quietly in bed under observation for the next 3 or 4 days. On the morning of the fourth day she reported a great deal of motion of the fetus and began to have contractions every 15 minutes. Examination at that time revealed a hard mass in the fundus and the uterus was considerably smaller than it had previously been; there was now a breech presentation. X-ray picture taken January 3 verified the diagnosis. I delivered her that evening of a 5-pound baby, double-footling presentation.

I believe it is extremely rare, if not unique, for spontaneous version to occur in a primipara from a cephalic to a breech presentation within a few weeks of term, 3 or 4 days after rupture of the membranes.

Dr. W. George Lee: What proof have we for rupture of the membranes? We have no statement as to the condition of the membranes during delivery or at that time.

Dr. Stein: In answer to Dr. Lee, I will say the rupture of the membranes was a true spontaneous rupture, and the birth was practically a dry one.

ETHER LAVAGE; ITS LOGICAL USE LOCALLY AS AN ANTI-AGGRESSIN

Dr. George de Tarnowsky presented a paper on ether lavage. (See p. 76.)

DISCUSSION

Dr. Arthur H. Curtis: In the technique of ether administration, is the abdominal cavity almost

Fig. 1. Roentgenogram taken 12 hours after rupture of membranes, dorsal posture, cephalic presentation.

Fig. 2. Same as Figure 1, lateral posture, postero-anterior. (Dr. Stein's case.)

Fig. 3. First stage of labor. Prone posture, breech presentation, 4 days after rupture of membranes.

closed and ether poured in, and is the dosage about 1 ounce?

Dr. Tarnowsky: The dosage of ether is about 1 ounce. I always start closing the peritoneum and then pour the ether in so that closure is effected before it begins to volatilize to any extent. Otherwise one loses most of it as a vapor. (Discussion on paper of Dr. de Tarnowsky.)

Dr. W. M. Thompson: I have seen a great deal of ether used, in joints more than in the abdominal cavity, and in the large number of cases that came before us in the Great War, an inconceivable number, one's observations could not be very accurate. We were groping for something to stop the infection. Flavine came out and that was tried. The Carrel-Dakin treatment came out and that was tried, but there were no sufficiently accurate observations in the organizations I was in contact with to get a really definite conclusion. I do know this, that a good many men in the British Army used ether and seemed to feel it was a great help, particularly in the joints. We used a great deal in the knee joints but I, myself, became more skeptical toward so-called antiseptic fluids as time went on and came to feel that I must clean out blood clots and débris, wash out with sterile water, and then close. I am very glad to hear such a definite statement from Dr. de Tarnowsky.

Dr. Charles B. Reed: I wish to have the Doctor emphasize his technique, for his use of ether in the prevention of adhesions.

Dr. George de Tarnowsky (closing): Answering Dr. Thompson's statement, of course ether will not take the place of any proper surgical procedure and for this reason every surgeon in the war realized that if proper surgery could be carried out everything else was unnecessary and that without proper surgery nothing is a complete success.

In regard to the use of ether in the uterine cavity, Lenhardt is the only one who has used it. I have not used it myself. The method he uses is very simple. He takes a small syringe and passes it into the uterine cavity in infections, and injects one-half to one ounce of ether. He prefers to warm the ether first. Preliminary warming does not appeal to me because ether volatilizes at body temperature anyway, but he seems to feel that if it is warm he gets better results.

SYPHILIS OF THE UTERUS AND ADNEXA

Dr. Bernard Portis presented a paper on: "Syphilis of the Uterus and Adnexa." (See p. 37.)

DISCUSSION

Dr. Wm. H. Rubovits: I saw this woman upon her admission to the Gynecological Ward of the Michael Reese Hospital. She was quite well nourished but anæmic, and seemed quite ill. Examination revealed nothing in the external genitals, nothing in the vagina, but a very large cervix which was soft except in the lower lip which was the site of an ulcer occupying about one-fourth of the area of the lower lip. There was nothing on the anterior lip. The size of the cervix was more than twice normal. The ulcer was indurated. Bimanual examination revealed, uterus only slightly enlarged with thickening in the adnexa. I felt justified in making a diagnosis of beginning carcinoma; the possibility of its being a luetic lesion did not occur to me. The removal of the organ was attended with difficulty that I had never experienced with a similar operation. The separation of the bladder from the uterus was very difficult, as well as the separation of the organ posteriorly. It was very bloody. There were apparently no lines of cleavage.

Dr. W. A. Brams: This report is very interesting and appears to be absolutely verified by the finding of the spirochætæ. I should like to ask several questions about the different histological verifications of syphilis of the walls. Which parts of the walls were syphilitic and what was the nature of the involvement? I should also like to ask what were the changes in the veins which were considered as specific of syphilis in other parts of the body? I would also like to know if there were any other demonstrable syphilitic lesions.

Dr. Thomas J. Watkins: Syphilis of the uterus is apparently of relatively infrequent occurrence. This is surprising as the uterus frequently harbors a syphilitic child and a syphilitic placenta. I can recall having seen only five cases of syphilitic uterus. It is logical to assume that syphilis of the uterus frequently occurs without being detected. In case of suspected chronic syphilis in the pelvis, my experience would suggest that a therapeutic test is far more valuable than a Wassermann test.

Dr. Emil Ries: Syphilis of the female sexual tract above the vaginal epithelium is unknown. Dr. Portis' case is a case of syphilis of the vaginal epithelium on the outside of the uterus, of the vaginal portion. That from there syphilis may invade the body is perfectly feasible but that does not make it syphilis of the uterus but a systemic infection of syphilis.

This report opens up many questions: for instance, that of the diagnosis of a doubtful ulcer on the cervix. Ten years ago a microscopical examination of the lesion would have settled the question of carcinoma quickly. Recently the edict has gone out that we must not remove a portion of a doubtful ulcer because these patients will all die, if a cancerous ulcer has been partly excised. That is a pernicious teaching. I have removed sections from numbers of patients on whom removal of the carcinoma has been performed subsequently and who are alive 10 years or more after the operation. Another point brought up by the report is this: suppose this case had been operated upon and the pathological examination had not been carried out with the tenacity of the Michael Reese staff, then this case would have gone on as carcinoma of the uterus cured and would have built up the statistics of vaginal hysterectomy for cancer. The practice of using X-ray and radium without obtaining microscopic diagnosis and then building up statistics of results without proper pathological examination is to be condemned for the same reason. All such statistics will be without value because not substantiated by proper microscopic investigation.

Dr. Bernard Portis (closing): I agree with Dr. Ries that a section should be removed from doubtful lesions of the cervix and a frozen section, or, better, the usual fixation methods should be used in order to determine the exact pathological process present. I had two cases of syphilis of the cervix while I was associated with Drs. Barrett and Culbertson at the Cook County Hospital. The diagnosis in those cases was made from tissue removed for histological study and the finding of a positive Wassermann reaction in the blood. We examined sections from the cervix, and corpus uteri, and ovary, but did not find any changes which we considered as pathognomonic of syphilis but rather that of a subacute diffuse interstitial involvement of the uterus and ovaries. It was only upon finding the spirochætæ in these two organs that we were certain of the correctness of our diagnosis. This was further substantiated by the development of a secondary skin eruption in the patient, and a positive Wassermann reaction in the blood.

Dr. Brams has asked if there were any changes in the arteries and veins which might be interpreted as due to a syphilitic involvement. After careful study of the changes in the arteries and veins, we concluded that the existing vascular involvement was that which one usually finds in the uteri of women past middle age. We could not demonstrate any definite mesarteritis, endarteritis, or a perivascular lymphocytic infiltration.

AMERICAN COLLEGE OF SURGEONS

SUMMARIZED REPORT OF THE COMMITTEE ON SCIENTIFIC MEETINGS OF THE *VANDYCK* CRUISE TO SOUTH AMERICA

By JAMES M. PATTON, M.D., F.A.C.S., Omaha, Nebraska, Recording Secretary

THE material in this article represents a summary of the scientific papers and discussions by the members of the recent cruise of the American College of Surgeons to South America. A summary of the activities of the Head Surgeons will appear in a subsequent article.

The meetings covered by this report were an important factor in providing scientific entertainment for the surgeons on board the S.S. *Vandyck*. They were organized and carried out under the direction of Dr. Charles D. Schaeffer, of Allentown, Pennsylvania, Chairman, and Dr. James M. Patton, of Omaha, Nebraska, Secretary of the Committee on Scientific Meetings, to whom, and to the other members of the Committee, the credit for the success of the meetings must be given.

Managing Editor.

The Executive Committee for the South American cruise of the American College of Surgeons appointed the following Committee on Scientific Meetings: Dr. Charles D. Schaeffer, Allentown, Pennsylvania, Chairman; Dr. Hugh H. Young, Baltimore, Maryland; Dr. A. J. Crowell, Charlotte, North Carolina; Dr. James T. Case, Battle Creek, Michigan; Dr. John Osborn Polak, Brooklyn, New York; Dr. T. Casey Witherspoon, Butte, Montana; Dr. G. A. B. Addy, St. John, New Brunswick; Dr. James M. Patton, Omaha, Nebraska, Recording Secretary; Dr. John George MacDougall, ex-officio, Halifax, Nova Scotia; and Dr. Franklin H. Martin, ex-officio, Chicago.

TREATMENT OF DEEP-SEATED CARCINOMA

The first meeting under the direction of the Committee was conducted on the evening of February 16, when Dr. Emil G. Beck, of Chicago, gave a most interesting address on "What Can be Done for Apparently Hopeless Cases of Carcinoma?" Dr. Beck emphasized the fact that surgeons and roentgenologists must co-operate in this work if they expect results. While superficial cancer may be cured by X-ray, deep-seated cancer cannot be cured by this treatment, because we cannot deliver into the seat of the tumor sufficient dosage of radiation without injury to the overlying or surrounding tissues; by subjecting the patient to such large doses as would be required to affect the growth, a roentgen toxæmia would be produced, which might kill the patient.

There is a method which makes the large dosage unnecessary and prevents the toxæmia. The deep-seated tumor, when feasible, is transformed into a superficial one, and the exposed field treated directly in the seat of the disease by exposure to radiation or insertion of radium into the bed of the disease. This method consists in the surgical removal of all overlying tissues, such as the skin, muscles, and bone, and as much of the tumor as is accessible or feasible. This leaves the wound fully exposed. No suture material whatever is used.

After the carcinomatous tissues have been eliminated, the wound will begin to contract, and gradually the skin from the edges will begin to regenerate and finally cover the entire denuded surface. The epithelization is further enhanced by adhesive plaster strips placed on the granulating border. The author has treated more than 160 cases by this method. His lecture was illustrated with slides showing all stages of the operation and the final results.

Dr. John P. Munroe, of Charlotte, North Carolina, presented an instructive discussion on heart lesions. He spoke particularly of the various phases of auricular fibrillations, heart block, etc., and while presented from the standpoint of the internist, it was of marked value and interest to the surgeons.

THE KIELLAND OPERATION FOR UTERINE PROLAPSE

Due to stops at Panama and Cartagena, no further scientific meetings were held until the evening of February 22, when Dr. Hermann J. Boldt,[1] of New York, gave an address, with illustrations, on "Operation for Uterine Prolapse, Devised by Dr. Christian Kielland of Christiania, Norway."

The object of the operation is to place the uterus, in its entire length, on the anterior surface of the vaginal wall, and to narrow the vaginal caliber.

The first step is to pull the uterus with a pair of bullet forceps to its fullest extent, outward and upward. A small wedge-shaped excision of the pos-

[1] For complete paper see Surg., Gynec. & Obst., 1923, xxxvi, 742.

terior lip is made, which, in ordinary cases, need not be wider at its base than half a centimeter. The incision is continued on either side downward for a distance of from 6 to 8 centimeters, gradually diverging. The flap is separated from the underlying structure, but not cut off; it is used for traction when the cervix is to be inverted. The width of this flap must necessarily depend upon the size of the prolapsus. On either side the vaginal mucous membrane is now separated a sufficient distance to grasp about half way, or in some cases even a trifle more, around the organ with the finger. When this has been done, one may begin to close the posterior wound, starting at the external opening of the vaginal portion, with a continuous catgut suture, taking in the stitches only the mucous membrane, and closing the wound to within about half a centimeter of its terminus, where the suture is tied but not cut off, since it may be desirable to use it later for traction purposes, when ready to invert the cervix.

We are now ready to operate upon the anterior wall. The organ is pulled downward, and the oval flap incision started about one-fourth of a centimeter beneath the urethral opening, which thus eliminates the urethral redundancy; it is carried downward, and a small wedge is excised from the anterior lip of the vaginal portion of the cervix. The exsections here, too, depend upon the size of the parts operated upon. It is understood that the excision from the portio vaginalis must be larger in the case of a voluminous, mushroom-like vaginal portion, than from one of normal size, since it is necessary to make a conically shaped portio, or else one will fail to invert the cervix.

When the flaps have been excised the vaginal mucous membrane on either side is separated the required distance. In the upper part the separation must be a trifle more, since this part of the vagina is used to cover the anterior surface of the uterine body. With this part of the intervention finished, we are ready to separate the bladder in the customary manner. But in the Kielland operation it should not be done so extensively laterally as in the Watkins or the Schauta Wertheim operation. One should be careful not to injure the bladder pillars of Luschka.

Now, with a pair of bullet forceps the body of the uterus is brought out and the fallopian tubes are either tied, or a small section, near the cornua, excised, to sterilize the woman, if she be still in the childbearing period.

The bladder peritoneum is attached to the posterior surface of the uterus at about the corporocervical junction. The uterus is placed in the position which it is henceforth to have, and a small drain is placed down to the corporocervical junction and brought out at the upper wound angle. After this is done the wound is ready for closure.

This, in a larger number of cases, is best done in two stages. Beginning at the external opening of the lip of the portio vaginalis, one sews upward to just above the corporocervical junction, but in this suturing one must also include the muscularis of the cervix. When this has been done, the cervix is ready to be inverted.

With the index finger of the right hand one pushes up the cervix, while simultaneously one pulls with the fingers of the left hand upon the flap left on the posterior wall, or on the suture left long, or possibly both. When the cervix has been inverted, which is usually readily accomplished, if it has been properly shaped, the distal half of the work is finished, and one feels, upon examining, only the anterior lip and the opening of the cervical canal. The rest has become obliterated to touch.

The rest of the wound is now closed. The sutures should, at least every second one, include also the muscularis of the body of the uterus. The first one is placed not higher than the origin of the round ligaments—never at the fundus, or on the posterior surface.

When the uterus is of senile size, or when the prolapsus is small, the anterior wound may be closed with a single catgut suture, but, as previously intimated, the two-stage closure is more convenient for most cases.

After the anterior wound has been closed, the pelvic floor is next given attention. The flap and the suture are now cut off, and the incisions continued where they were left off, making the Hegar denudation and subsequent closure. The drain is removed about the third day.

Kielland asserts that he has not seen a recurrence in more than 150 operations, if the proper selection for the operation has been made. He has been doing the operation more than 10 years.

The fact should be emphasized that all operations devised are of benefit in properly selected cases. One should never adapt the condition to the operation, but always the operation to the condition. There is only one operation from which a permanent result can always be guaranteed; the vaginal pancolpohysterectomy, but this is very seldom indicated. The author has not averaged more than one such operation a year, during all the years that he has used it.

ANÆSTHESIA

The first general meeting of the scientific section was held on February 24, the subject under discussion being "Anæsthesia." The Chairman briefly reviewed the early history of anæsthesia and emphasized the importance and responsibility of the anæsthetist. Dr. Frank E. Bunts, of Cleveland, Ohio, spoke on "The Nurse Anæsthetist," of which the following is a summary:

THE NURSE ANÆSTHETIST

One of the greatest advances in the administration of anæsthetics has been the advent of the nurse anæsthetist. The technical education of a physician is not necessary to acquire the ability to administer anæsthetics. The young graduate in medicine is

certainly not qualified to do it by reason of the teaching received while pursuing his medical course in college. The postanæsthetic troubles of the patient in the days when anæsthetics were administered by the interne are a matter of deepest regret to the surgeon accustomed to the almost eventless postanæsthetic state of the patient anæsthetized by the skilled, highly trained nurse anæsthetist. Her undivided attention to her work is in marked contrast to the almost unavoidable interest taken in the operative procedure by the medical graduate.

The responsibility for the patient must be assumed by the operating surgeon, whether the anæsthetist be a nurse or a physician. I am unwilling that the anæsthetist should decide for me whether or not the patient is a fit subject for anæsthesia. It is my responsibility, and I must assume it. I am at a loss to understand how one who has spent the time and money necessary to acquire the broad education of a physician, can willingly confine himself to the narrow specialty of administering anæsthetics, and in the final analysis, after all other special arguments have been advanced, I find its advocates resorting to the final and apparently, to them, conclusive argument—that it is depriving the physician of a legitimate and much prized source of revenue. We must not forget in this connection that it is the patient's safety and comfort that must receive first consideration, and not the doctor's pocketbook. At the hospital with which I am connected between five and six thousand operations are performed each year under general anæsthesia. With few exceptions, all anæsthetics are given by nurse anæsthetists, and in a number of years, I can not state offhand how many, there have been but two anæsthetic deaths, and both were cases where the anæsthetic was administered by a physician.

The World War demonstrated beyond any question the value of the nurse anæsthetist. Without her, our work in cantonment hospitals and in our service abroad would have been greatly hampered by the inability to secure properly trained anæsthetists among the medical officers in the army.

I wish it were possible for the great influence of this College of Surgeons, extending as it does into every part of America, to be definitely used not to forbid the physician to give anæsthetics, should he decide that that is what he is best qualified to do, but rather simply to assure the public and our state legislatures that we do approve of the nurse anæsthetist and that her abolition would be a calamity, not only to our largest and most active hospitals throughout America, but far more to the people themselves who may some time unfortunately have to pass through the ordeal of anæsthesia.

This paper was discussed by Dr. James Y. Welborn, of Evansville, Indiana, who believed that the anæsthetist should be a doctor and that nurses are fitted only for nursing. Nor did he think that an interne was qualified for this work; he insisted that the anæsthetic should be given only by a specialist devoting his entire time to this line of work.

Dr. Hugh H. Young, of Baltimore, Maryland, was of the opposite opinion and cited the work done at the Johns Hopkins Training School for Nurses, which devoted a specified period of time to the training of the nurse anæsthetist. He did not object to a doctor giving an anæsthetic when he was doing enough of this work to be qualified really to do it properly.

Dr. W. F. Grinstead, of Cairo, Illinois, said he employed nurses who are especially trained to administer anæsthetics, but he felt that the anæsthetist should be thoroughly familiar with the diagnosis and condition of the patient so that the anæsthetic may be given to the best advantage.

Dr. John F. Barnhill, of Indianapolis, favored the doctor as being better qualified for the administration of anæsthetics than the nurse, because of his broader training and experience.

GENERAL ANÆSTHESIA BY ETHER, CHLOROFORM, AND GAS

Dr. James Y. Welborn, of Evansville, Indiana, gave an excellent discussion on "General Anæsthesia by Ether, Chloroform, and Gas," which, in part, was as follows:

There is nothing very new in the use of general anæsthesia. In the short time at my disposal, I can only tell you in substance of my experience, and the conclusion which I have arrived at after 25 years of work in a hospital of 72 beds.

While chloroform is a good anæsthetic, it is not the safest for us. It is probably used more generally throughout the country on account of its accessibility. Ether, considering all conditions, is in my opinion the most efficient and safest of all anæsthetics.

At our hospital where a physician devotes his entire time to giving anæsthetics and where about twelve hundred anæsthetics are given a year, I prefer gas. However, the conditions present usually indicate the kind of anæsthetic.

We find it most convenient to do our work in the following manner: One apparatus is used for gas-oxygen alone; another for gas-oxygen-ether; and the third for gas induction to be followed by ether. I do not know definitely, but McKesson claims that, regardless of the duration of operation, not over six or eight hospitals in the United States use gas alone for all operations. When gas alone is used there are four stages considered; the first and second stages are usually stages of uneven anæsthesia; the third stage is that in which most of our operations are done and consists of four strata; usually the operating is done in the first stratum, which is complete anæsthesia. In the second stratum there is apt to occur a spasm of the muscles, due to the use of too high a percentage of gas, and improved by the addition of oxygen. Herein lies the greatest danger in gas being administered by an inexperienced anæsthetist, who misconstrues this condition, taking it as too light anæsthesia and gives more gas, thereby causing death, when instead

it is too deep anæsthesia. The fourth stage is that in which death occurs.

Therefore, I say that a skilled anæsthetist is of the utmost importance.

In the general discussion, Dr. John Osborn Polak, of Brooklyn, said that he did not feel that gas anæsthesia was as safe as the author seemed to infer; but Dr. James T. Harrington, of Poughkeepsie, New York, thought that the conclusion that gas was unsafe might be due to the fact that many doctors are not qualified to give gas anæsthesia. Dr. E. R. Secord, of Brantford, Ontario, and Dr. Truman W. Brophy, of Chicago, advocated the use of chloroform in certain cases, favoring it especially in young children and in the presence of pulmonary irritation.

SPINAL AND CAUDAL ANÆSTHESIA

Dr. James T. Case of Battle Creek, Michigan, was asked to discuss "Spinal and Caudal Anæsthesia," and a summary of his remarks follows:

As to caudal anæsthesia I have not formed a very favorable opinion, for the reason that too large a quantity of novocaine must be injected to secure anæsthesia and too long a time elapses between the injection and the production of satisfactory anæsthesia. Nevertheless in occasional cases I employ this method, injecting 30 to 60 cubic centimeters of 1 per cent novocaine into the sacral canal, taking pains not to puncture the membranes and withdraw spinal fluid. If it happens that spinal fluid escapes through the needle, we virtually give an intraspinal anæsthesia.

Lumbar anæsthesia has been growing very rapidly in popularity during the last few years. In Germany and France it is very extensively used. In many clinics all major surgery of the lower abdomen and pelvis is carried out under lumbar anæsthesia. On this trip in South America we shall see a great deal of this type of anæsthetic. Professor Arce of Buenos Aires is not only one of the leading surgeons of South America, but one of the leading exponents of lumbar anæsthesia. (I prefer the term "lumbar" to "spinal" for the reason that many physicians and most laymen are frightened at any discussion of a *spinal* injection for diagnostic or anæsthetic purposes.)

The technique which I employ is that taught me by Professor Gosset, of Paris. The solution employed is solution C of scurocaine which I have procured from Paris through a house in New York. I shall be glad to furnish this address to any of you. Each ampule contains 3 cubic centimeters of 4 per cent novocaine in salt solution. Some of the preparations contain adrenalin and some do not. For the spine I think it is not necessary to use adrenalin. One needs a spinal puncture needle of the ordinary type with an ordinary hypodermic syringe of 10 cubic centimeter capacity which fits the spinal puncture needle. Other instruments at hand should be an ampule of caffeine, a sharp pointed scalpel, and a container for fluid to be used for examination for the spinal fluid Wassermann. The ampule of scurocaine is broken and its contents aspirated into the hypodermic syringe.

Two hours before the operation the patient receives a quarter-grain of morphine with one-five-hundredth of scopolamine. An hour later the patient receives a sixth grain of morphine with one-five-hundredth of scopolamine. Just as he is brought into the operating room, he receives an ampule of caffeine hypodermically. The patient's blood pressure should be taken just before the injection.

The patient is injected preferably in the erect position sitting on the side of the operating table or the side of the bed, the arms crossed, and the chin touching the chest. The back is arched slightly forward. The needle is introduced into the spinal canal between the third and fourth or between the fourth and fifth vertebræ—never higher. From 8 to 20 cubic centimeters of spinal fluid is withdrawn depending upon the level at which we wish anæsthesia and upon the amount of intraspinal pressure. If the fluid spurts out we withdraw more fluid. The higher the level to which anæsthesia is desired, the more the amount of fluid withdrawn. The necessary amount of fluid having been secured, the hypodermic syringe containing the 3 cubic centimeters of scurocaine 4 per cent solution is now fitted to the spinal needle and the plunger withdrawn until 6 or 7 cubic centimeters more of spinal fluid have been added to the scurocaine in the syringe. The contents of the syringe are then expressed into the spinal canal,—quickly and forcibly if a high level of anæsthesia is desired, slowly and gently if a low level of anæsthesia will suffice. The needle is withdrawn, a small dressing applied, and the patient placed in the horizontal position with extra pillows under the head to maintain sharp flexion of the neck, with the chin touching the chest.

In most cases the patient is at once ready for operation, the anæsthesia being immediate and complete below the umbilicus. If not, it becomes effective within a minute or two. Very seldom, indeed, is it necessary for the surgeon to wait; for by the time he changes his gloves and the patient can be draped the operation may be begun. If the patient is not anæsthetized in the pelvis and lower extremities, it suggests that the injection must have been extradural. It sometimes happens, especially early in one's experience, that the end of the needle does not lie frankly within the spinal canal, and in the slight manipulation of adjusting the needle the end slips outside the canal, so that the injection is not made into the spinal fluid. In such instances there are local areas of anæsthesia; but the purpose of the injection has not been achieved. It is my custom in such event to go ahead at once with the administration of a general anæsthetic. In our first hundred cases we had only three cases of failure of the anæsthetic, due, I believe, to this cause. In the next hundred cases only two failures, and now failure is very exceptional. If the anæsthesia has begun in the suprapubic region but does not reach high enough, the pillows are removed, the head extended, and the

patient placed for 30 to 60 seconds in the Trendelenburg position. The rapid extension of the anæsthetized area will be observed at once. The head is again flexed as soon as a sufficiently high level of anæsthesia is apparent. I cannot explain the value of head flexion; but it nevertheless is a point of technique to which I still carefully adhere.

Naturally the blood pressure will begin to drop as soon as the anæsthesia is achieved, just as a drop of blood pressure is noted in cases of sudden paralysis from any cause. There are undoubtedly alterations in the vascular tone of the anæsthetized parts which permit a definite drop of blood pressure; and this we must expect. As soon as a satisfactory grade of anæsthesia has been achieved I immediately start the hypodermic introduction of caffeine, and three or four ampules are given at intervals of 10 minutes during the operation if it lasts that long. As the operation proceeds a definite decrease in blood pressure will be noted, the systolic pressure dropping, for instance, from 130 or 140 before the injection to 90, 80, or even lower as the operation proceeds. I have seen a drop to even as low as 65 systolic. This does not alarm me for I have seen it repeatedly and have come to realize that it is a stage of the anæsthesia to be expected in certain cases of high injection, that its appearance is not alarming, and that it can be immediately raised if indication presents by the administration of nitrous oxide anæsthesia. At first I was much alarmed by the low blood pressures occurring fifteen or twenty minutes after the injections. Now I naturally watch these cases carefully; but I am not alarmed about them. I have never had a fatality attributable to the lumbar anæsthetic.

The relaxation secured by lumbar anæsthesia is highly satisfactory. "Abdominal silence" is realized to an unusual degree. Retractors are frequently unnecessary, because the abdominal muscles are so absolutely relaxed. The intestines are contracted as a result of the injection and for this reason one is not troubled with gas distention of the small intestine. In fact, it is important in the preparation of the patient not to use enemas within 3 or 4 hours of the time of the operation for fear the patient's bowels will move and thus soil the table. In gynecological work I always pack the vagina to avoid possible soiling by an unexpected bowel movement. This accident rarely happens if the precaution is taken to give no enemas within 3 or 4 hours of the operating time. If the Trendelenburg position is needed one need not fear to put the patient into an exaggerated inverted position. When the zone of anæsthesia has once been settled, it seems to spread no further even though the flexion of the head be neglected. I still continue, however, to keep the head sharply flexed, especially with the patient in the Trendelenburg position.

Even the slightest bleeding vessels should be tied off for fear of a postoperative bleeding when the blood pressure is restored. I have not had any accidents of this type, however.

The anæsthesia lasts from 45 to 90 minutes. Occasionally it will persist for an even longer time. Hence, most operations on the pelvis can be completed within the normal anæsthetic period by this method. If longer anæsthesia is required, there is no danger but rather a benefit in supplementing the lumbar anæsthesia by nitrous oxide general anæsthesia. As above intimated if the blood pressure should drop to an alarming point following injection I have occasionally employed gas and oxygen, because of its known tendency to increase the blood pressure. The blood pressure readings should be carefully taken by the anæsthetist and the surgeon informed of any serious changes. As soon as the blood pressure begins to rise any apprehension which may have been aroused may end.

One of the signs which should cause apprehension is vomiting. A tendency to nausea may in most cases be averted by pinching the patient's nostrils, thus forcing mouth respiration; the application of ice bags or cold compress over the neck; and by the avoidance of all unnecessary movement or talking. Absolute silence is maintained in the operating room except between the anæsthetist and the patient, and talking by the patient is not encouraged. It is our custom to place a large cold compress over the eyes and hanging down the sides of the head over the ears, still further to distract the patient's attention from the operating room sights and sounds. Those surgeons who are accustomed to place a colon tube in the rectum before operation for the purpose of injecting the colon with an enema during the operation, should realize that the anal sphincter is paralyzed and such introduction of tubes is not possible without danger of soiling the table.

The immediate danger is respiratory failure. I have not seen any suggestion of this in any of our patients, neither have I learned of such cases of respiratory failure in any clinic where the injections are made only below the third lumbar vertebra and where only novocaine is used. I never employ stovaine or any of the other substitutes for novocaine. In case respiratory failure should occur, however, Professor Gosset and his associates, especially Block and Desplas, have shown that the intradural injection of an ampule of caffeine in dogs will at once overcome the respiratory failure. I am told by Gosset that in any event, it is only necessary to carry on artificial respiration until the anæsthetic wears off, which means for 30 or 40 minutes at the longest. In case of a possible heart arrest, which I have not yet seen, I always have in readiness an ampule of adrenalin and a second spinal puncture needle, so that I am prepared for the injection of adrenalin into the heart muscle.

It is suggested by some that vomiting is a danger sign and indicates that the zone of anæsthesia is approaching the ventricles. I have, however, not seen any untoward results in any case. The literature tells of occasional fourth cranial nerve paralysis coming on several weeks after the lumbar injection and persisting for 6 or 8 weeks. None of our patients

has developed diplopia. I have always heard of headache as one of the contra-indications to lumbar anæsthesia. This occurs in about 4 per cent of our cases. We believe it is due to an insufficient withdrawal of spinal fluid before injecting the novocaine and we find that it is relieved by a further withdrawal of several cubic centimeters of spinal fluid. Headache is conspicuous by its absence among our patients.

Most of the cases call for food the first evening. In a series of eight hysterectomies, four done under lumbar and four under general anæsthesia, the convalescence of the four under lumbar averaged 3 days less than the four under general anæsthesia. It is our observation that the convalescence is much less likely to be complicated following the lumbar than after a general anæsthesia. Vomiting rarely occurs except in the operating room, and it should be prevented there.

We prefer this type of anæsthesia for all gynecological operations and other pelvic operations which require 20 minutes or longer and for all operations on the extremities which are of a major type. Prostatic and bladder surgery are nicely suited to this anæsthetic. Most satisfactory of all is the employment of lumbar anæsthesia in the repair of ventral hernia, for the extreme relaxation of the muscles makes very easy a satisfactory hernia operation. I only rarely deliberately undertake a gall-bladder or stomach operation under lumbar anæsthesia; but I never hesitate to operate for gall stones when, for instance, I find them accidentally during the course of a pelvic operation of not too great severity. The greater rapidity with which one can operate when complete "abdominal silence" has been achieved is one of the greatest advantages of lumbar anæsthesia, and one can go ahead with an additional cholecystectomy with this form of anæsthesia when he might not otherwise attempt it. I have done a number of posterior gastro-enterostomies under local anæsthesia by the ordinary infiltration method.

I do not employ this form of anæsthesia for short operations, feeling that while I have not encountered any mishaps, nevertheless the average sentiment against lumbar anæsthesia is so great that should I perchance have a mishap with a minor case I would be subject to grave criticism. So for all minor surgery on the pelvis or lower extremities I employ nitrous oxide-oxygen anæsthesia when it is not possible to employ local anæsthesia by the ordinary infiltration method. It has been my custom not to use lumbar anæsthesia with young people or with any one whose systolic blood pressure is lower than 100. Any previous history of meningitis or meningeal irritation of any kind (as lues) also constitutes a contra-indication.

I seldom *urge* a patient to take the lumbar anæsthesia in preference to a general anæsthesia. I frequently say nothing about the kind of anæsthetic until the patient is in the operating room. I then explain that the operation can be performed under local anæsthesia and the patient usually tells me to go ahead if I think it is best. I assure him that the anæsthetist with the gas-oxygen anæsthesia is ready at hand, and that if I fail to keep my promise not to hurt, the gas can be administered immediately. If the patient refuses the local anæsthesia I, of course, do not urge it unless there is some strong clinical indication against general anæsthesia. Should gas-oxygen be required in addition to puncture, much less gas will suffice. I believe the day will come when patients will wonder not why it is best for them to stay awake during an operation, but rather why they must go to sleep.

I should add that it is not necessary to use a fluid preparation of novocaine. One can prepare the dry novocaine powder or tablet. The amount of novocaine injected is from 0.10 to 0.12 gm., the average dose being about 0.10 gm. per each 15 pounds of body weight. The spinal fluid, after wasting the first few drops, is allowed to flow into a special tube containing the sterile novocaine. More fluid or less fluid is withdrawn according to the intraspinal fluid pressure as above noted and some of the fluid is laid aside for analysis. The solution thus made is aspirated into any kind of a syringe by means of a spare needle, the hypodermic syringe is then fitted to the spinal puncture needle, and further withdrawal of fluid made into the syringe until it is filled. The plunger is then discharged very slowly until about half of the syringe is empty and new fluid is aspirated and re-injected until by the end of four to six injections the syringe is emptied. The patient is then managed as above noted.

Dr. Samuel J. Mixter, of Boston, approved of spinal anæsthesia, especially in acute intestinal obstruction and in senile gangrene. He had also found it helpful in cases of postoperative distention. Dr. Case added that he had found hypodermic injections of pituitrin helpful in the last-mentioned condition.

LOCAL ANÆSTHESIA

The subject of "Local Anæsthesia" was then presented by Dr. Frederick B. Mowbray, of Hamilton, Ontario, as follows:

Local anæsthesia of the infiltration type is applicable in a wide range of procedures, including hernias of all types; abdominal sections where little or no dragging on the mesentery is anticipated; rectal and perineal surgery; as well as goiters; cranial, laryngeal, and tracheal work; and all operations of a superficial type.

Results cannot be attained without careful administration, having in mind always the anatomy of the parts. Then the correct anæsthetic must be used which, in most cases, is novocaine in strengths varying from $^1/_5$ to $\frac{1}{2}$ per cent. If adrenalin is combined with it, 3 minims of stock solution may be added to each ounce of novocaine solution.

When local anæsthesia is used, the surgeon must employ sharp dissection and avoid rough manipulation, because dragging sensations are not abolished even though painful ones are. Then, too, dragging

on the parts, especially in the abdomen, is sure to disturb nerves which have not been blocked. All abdominal viscera may be handled, provided the mesentery is not pulled upon.

In all operations one must block all the nerves reaching the operative field. This may be done by (1) injecting directly with the nerve at some distance from the field; (2) infiltrating all the tissues at least 1 to 2 inches from the field by a series of superimposed injections so arranged as completely to encircle the operative area. This may be accomplished by a subcutaneous, subfascial, intramuscular or extraperitoneal injection, as demanded by the individual case.

Always wait at least 15 to 20 minutes (by the clock) before commencing the operation. Be gentle in all manipulations!

RECTAL ANÆSTHESIA

As there was no general discussion, Dr. William Bryan, of West New Brighton, New York, was asked to present the subject of "Rectal Anæsthesia." His remarks follow:

When for any reason the inhalation method is contra-indicated as in operations on the face or throat, when inflammation is present, when there is undue sensitiveness of the bronchial mucous membrane, or there is fear on the part of the patient, resort may be had to rectal administration.

We use 75 per cent ether and 25 per cent olive oil. The patient is given a thorough cleansing enema in the afternoon and forenoon. One hour before beginning anæsthesia we give patient

Paraldehyde—℥ii per rectum
Morphine sulphate, gr. ¼ hypodermatically.

The room should be kept absolutely quiet and no talking allowed. Patient is placed on the left side with hips elevated.

The ether-oil solution should be in a glass container held about 12 to 15 inches above the body and should be allowed to flow by "gravity"—amount used being 2 ounces for each 20 pounds of body weight. From 5 to 10 minutes should be allowed for the giving of the entire amount. Usually ether can be detected on patient's breath in 11 minutes. Complete surgical anæsthesia should exist in from 15 to 18 minutes.

When the operation is completed the excess of ether-oil solution should be withdrawn from the rectum, and should be replaced by an equal quantity of olive oil.

If during the operation the patient's condition is not good, or if breathing should seem poor, a few inhalations of nitrous-oxide gas will be all that is necessary.

There are no contra-indications to this form of anæsthesia, except the presence of an ulcerative colitis or similar conditions about the rectum.

It is not an ideal procedure for use in children and is not advised; but if it is to be used it should be not stronger than ether 50 per cent and oil 50 per cent.

Dr. Harrington discussed "Rectal Anæsthesia" further, stating that he found this anæsthetic particularly satisfactory in operations about the head, extremities, and breast, but not so good in abdominal work. He used 75 per cent ether and 25 per cent olive oil, administering 1 ounce of the above mixture to every 20 pounds of body weight, obtaining anæsthesia in about 25 minutes. If anæsthesia is not complete, it may be induced by giving a few inhalations of ether. Should alarming symptoms appear, the colon should be promptly drained. Dr. Harrington mentioned one fatality in a very elderly patient, but was not sure that this was due to the anæsthetic.

Dr. Ross Miller, of Amherst, Nova Scotia, told of the use of oral anæsthesia in overseas service: 1½ ounces of ether was used to an ounce of liquid parolene for the average sized patient of, say, 150 pounds. One-third of a glass of port wine was given immediately before and after the administration of the mixture. He said there was very little postoperative discomfort, and the patient was often able to get up and leave the hospital as soon as he was awake.

CHOICE OF ANÆSTHETIC

The subject of anæsthesia was continued February 28. In opening the discussion Dr. F. N. G. Starr, of Toronto, Ontario, said that in his opinion the anæsthetic of choice for abdominal surgery is ether. He said that it is true that with a combination of gas, oxygen, and ether extensive operations may be done with a minimum of ether after relaxation is once obtained. In his experience gas-oxygen alone is rarely satisfactory for operations upon the upper abdomen because of the difficulty in obtaining complete relaxation. If this is not obtained it makes it difficult for the surgeon to employ the necessary gentleness that should obtain in the handling of intra-abdominal contents.

During the course of a year Dr. Starr operates upon a great many doctors and members of the families of doctors but he has never yet had a doctor request that the anæsthetist should be a nurse.

In the preparation of a patient for an anæsthetic his psychology must be studied and dealt with just as much and as carefully as any other part of the operation. It is important that patients should be fed and not starved.

Lumbar anæsthesia and local anæsthesia has a place and an important place in surgery. The author has not for years attempted a goiter operation with local anæsthesia and for this reason a former goiter patient said: "Do not do goiters under local." Upon asking "Why, had she been hurt?" she replied: "No, I did not feel any pain, but when you delivered that lump out of my neck, I felt as I have often imagined a turkey feels when it is being drawn—only from the opposite end."

In discussing the comparative merits of the trained physician anæsthetist as compared with the nurse anæsthetist, Dr. Starr said: "A man is a law

unto himself. Unfortunately some surgeons appear to think they should be a law unto the universe!"

During the early days of the war when the supply of doctors was limited, the British sent nurses to be trained in administering anæsthetics. Only about one in each 100 became proficient—that one became a marvel in proficiency but the scheme was later abandoned.

At Toronto in the General Hospital there is a chief anæsthetist and 8 or 10 assistants. Each student in his final year gives at least 6 anæsthetics under the supervision of a trained anæsthetist. While this does not make the student a specialist, upon graduation he understands the principles and if he desires to take up anæsthesia as a specialty, he has the ground work upon which to build his specialty just as any other student has for the other specialties.

Dr. Boldt's discussion follows:

I know nothing more valuable as a safety device in instances of patients in unfavorable condition for operation than the use of the tourniquet, particularly if we have reason to believe than there may be a large quantity of blood lost, or in operations that are likely to consume considerable time. To enhance the value of the appliance, in a few instances I have made use of bandages at the conclusion of the operation, to direct the blood from the extremities toward the trunk, and the improvement of the pulse is remarkable.

It is an error to assert that any one anæsthetic is perfectly safe. I have had the misfortune to have deaths from all anæsthetics, except methyl chloride, and that I have never used. But ether, chloroform, nitrous oxide gas, and lumbar analgesia have caused the death of patients in my hands.

In connection with lumbar analgesia, I would call attention to the desirability of using preliminary narcosis, starting 2½ hours before the beginning of an operation, giving a hypodermic injection of 1/180 grain of hydrochloride of scopolamine and 1/12 grain of morphine; a second injection 1 hour later; and a third injection, if the patient is not very drowsy, at the lapse of the second hour. By the time the operation is begun, it will usually be found that the patient is in a more satisfactory condition for operation, and the lumbar puncture can more readily be made without apprehension on the part of the patient. It is desirable to blindfold the patient at the time of giving the first hypodermic injection, to put cotton into his ears, and also to avoid loud talking in the operating room. Where these details are observed, I have frequently had such patients sleep during the operation.

One should never insist upon the use of any particular form of anæsthetic. Although, as a rule, ether may be considered the safest in the majority of cases, upon the substitution of chloroform, if the patient is unsuitable for ether, the anæsthesia has progressed without the slightest hitch.

In long operations, as a radical operation for cancer of the cervix, I prefer to use lumbar anæsthesia.

Dr. J. Wesley Andrews, of Mankato, Minnesota, preferred gas-ether anæsthesia as a routine. Dr. Effie L. Lobdell, of Chicago, expressed the opinion that the preparation of the patient for the anæsthetic should be started as soon as the patient enters the hospital. The anæsthetist should gain the patient's confidence and avoid as far as possible all pre-anæsthetic shock. Dr. Lobdell also emphasized the importance of a careful general examination, and favored the administration of morphine and scopolamine before either local or general anæsthetic.

ANÆSTHESIA OF NOSE AND THROAT

Dr. Truman W. Brophy, of Chicago, presented the subject of "Anæsthesia of the Nose and Throat":

Before administering an anæsthetic the final consideration should be the preparation of the patient. A very large majority of my patients are infants. Many of these infants are poorly nourished, have been given improper food and are suffering from gastro-enteritis. Such patients, as we know, are not in condition to be given an anæsthetic. I put them under the care of a pediatrician who treats them until they are in satisfactory condition to take an anæsthetic and to be operated on. The diagnosis of the child's general condition is of the greatest importance. Enlarged thymus gland, status thymolymphaticus, acidosis, gastro-enteritis, rickets, etc., must be considered and treated.

Enlarged thymus may be recognized by percussion but more certainly by a good roentgenogram.

The enlarged gland may be reduced to normal size by treating with X-ray. One treatment is usually sufficient to reduce the enlargement to normal size, after which within a month or 6 weeks an anæsthetic may be given with usual safety.

We frequently find acidosis. As a routine we give sodium bicarbonate 4 or 5 days before we operate, X-ray the chest looking for enlarged thymus, eliminate gastro-enteritis, and note that the child is gaining weight before we operate.

In my opinion the position of the patient while taking the anæsthetic is of great importance. He should be in a recumbent position or even with the head lower than the body so as to get the benefit of gravity in carrying the blood to the nerve centers, thus abundantly supplying the nerve centers of the brain.

The anæsthetic which I use, almost to the exclusion of others, is ether. We know it is contraindicated in the presence of advanced nephritis and bronchitis, yet ether is the anæsthetic agent of choice in nearly all other maladies.

Extending over a period of about 20 years I used chloroform nearly always. Infants take it well. However, as I found so much opposition to it in the profession and as medical internes while in college had not been trained to administer it, and as anæsthetists are indisposed to give it, I concluded that I would not further insist upon its use. Therefore I now use ether almost exclusively. Nitrous-oxide-oxygen an-

æsthesia is very desirable in many operations. Tonsillectomies may be very successfully performed with its use, but it is not indicated in children and in prolonged mouth operations.

Within the last year a patient with whom I had previously had trouble following the administration of ether, returned for the last stage of a series of plastic operations. Previously I labored with him 16 hours to restore and maintain normal respiration after ether. I resolved to use morphine and scopolamine. I sent for an expert in its use and began with the first injection at 7 o'clock in the morning. He was taken to the operating room at 9:30. An operation occupying one and one-quarter hours was performed while the patient was completely anæsthetized. He was returned to his room, where after making rounds, I called about 2 hours after operating and found him talking to his nurse. Had I administered ether I doubt if he would have survived it.

CHOICE OF ANÆSTHETIC IN UROLOGY

Dr. H. H. Young presented the subject of "Choice of Anæsthetic in Urology."

The general rules as to the anæsthetic to be used are much the same as for other branches of surgery; but in urology the frequency of operations in aged men with prostatic diseases is so great that the age limit is very high. The kidneys are more frequently diseased, infections, stone, true nephritis, and back pressure impairment of function being commonly met with and adding to the gravity of anæsthesia. Cardiorenal disease is quite common in old men, and arteriosclerosis and high blood pressure, with cerebral symptoms, are often seen and cause grave concern where operation is imperative.

In a recent series of 1049 perineal prostatectomies, 370 patients were over 70 years of age and 31 over 80.[1] With very great age the mortality becomes progressively higher, being at 70 years 2.5 per cent, between 75 and 79 years, 5.3 per cent, and between 80 and 84 years, 7.1 per cent in my series of cases.

In the presence of diseased kidneys, ether is dangerous, and nitrous oxide or spinal anæsthesia is to be preferred. But in high blood pressure, marked arteriosclerosis and cerebral cases, nitrous oxide is dangerous on account of the increase in blood pressure produced. In some of these cases spinal anæsthesia, which lowers the blood pressure, would seem to be best to use, but it often causes so marked a lowering of the blood pressure as to predispose to cerebral thrombosis, so that ether, with its supportive action to the heart and only slight pressure-increasing effect, is preferable in these cases, as it is also in cases suffering from almost all kinds of cardiac disease.

In a consecutive series of 198[1] perineal prostatectomies without a death, there were 79 cases with the blood pressure over 150, 21 cases over 180, and 5 over 200, nearly all of the high blood pressure cases being done under ether anæsthesia. In this same series of 198 cases there were 34 in which the heart was enlarged, 30 with murmurs present, 16 both enlarged and with murmurs, and 16 with myocarditis, a total of 96 cases, or nearly 50 per cent.

[1] Surg., Gynec. & Obst., 1923, xxxvi, 589.

Before determining the anæsthetic, careful functional studies of the kidneys should be made. For this purpose the phthalein test is much more helpful and accurate than ordinary urinalyses, as casts and albumin are often absent in severe renal disease.

Where the phthalein output in 2 hours is below 40 per cent, a blood-urea test should be done, and if over .50 grams per litre, most careful preparatory treatment should be given before operation, especially under a general anæsthetic. The phthalein test is so simple and so valuable that it should be employed as a routine in surgical cases. Blood chemistry is usually not necessary unless the phthalein is low.

The wonderful results which are obtained by catheterization in cases of back pressure due to enlarged prostate, are among the most gratifying things in surgery. Even severe uræmias, with almost no phthalein excretion, are ultimately restorable to fairly good function and operability by this means.

Diabetics are likewise to be brought into good condition for anæsthesia and operation by prolonged careful diatetics and insulin treatment. In tuberculous conditions of the urinary or seminal tracts, ether is to be feared on account of the frequent presence of pulmonary tuberculosis, active or arrested, which may be lit up by ether. In such cases I employ spinal or caudal anæsthesia or local injections of procaine in many cases.

But for general use I prefer nitrous-oxide-oxygen as an anæsthetic, adding ether only when necessary in prolonged operations, or to get more complete relaxation. Nitrous-oxide is especially good in the presence of chronic infections of the mouth or respiratory tract, when postanæsthetic pneumonias are to be feared. We make it a rule to wait until acute "colds" are recovered from, and occasionally to submit patients with badly infected tonsils or sinuses to operation or treatment for these diseases before undertaking urological operations under general anæsthesia.

To recapitulate, my opinion as to the choice of anæsthetic in urology, is this: ether, in the cardiac and cardiovascular cases; spinal, caudal or local procaine in the tuberculous or bad renal cases, bad nasopharyngeal and pulmonary infections; nitrous-oxide-oxygen (with as little ether as practicable) in the majority of cases, and especially the mild nephritics. By adequate functional tests, painstaking preparatory treatment and careful choice of anæsthetic, patients who were formerly considered grave risks may now be safely carried through even severe urological operations.

ANÆSTHETIC OF CHOICE IN ORTHOPEDIC SURGERY

Dr. R. D. Kennedy, of Globe, Arizona, in discussing "Anæsthetic of Choice in Orthopedic Surgery," said:

Local anæsthesia is of great service in tendon reconstruction of the forearm. This is particularly true when the anatomy has been distorted by scar tissue or otherwise, inasmuch as the patient can be of great help in enabling the surgeon to identify the anatomy, thus lessening the necessity of extensor dissection in order to recognize the different structures.

ANÆSTHESIA IN GENERAL SURGERY

Dr. T. Casey Witherspoon, of Butte, Montana, speaking of "Anæsthetic of Choice in General Surgery," said that an examination by a competent internist is of value when there is any question at all about the kind of anæsthetic to be administered. While he personally prefers ether in general and procaine in local anæsthesia, he urged every man to become thoroughly familiar with one local and one general anæsthetic, so that he would have an instinctive knowledge of the condition of the patient as he was operating. He could see no reason for using a solution of procaine stronger than 1/5 of 1 per cent.

On opening the scientific section March 1, 1923, the chairman, Dr. Schaeffer, announced a continuation of the general discussion of anæsthetics. In discussing the relative merits of the nurse and doctor anæsthetist, Dr. Secord and Dr. Starr were very positive in their preference for the physician anæsthetist. Dr. Secord intimated that the principal reason for employing a nurse anæsthetist was due to a desire to save money, and Dr. Starr felt that if internes were given the training they *should* have, the anæsthetics would be much safer than those given by the nurse. Dr. W. J. Brooke, of Bayonne, New Jersey, said that the question is largely one of local custom and convenience, but he felt that where a physician who specializes in anæsthetics is available, he is generally superior either to the nurse or to the recently graduated interne. Dr. L. H. Taylor, of Wilkes-Barre, Pennsylvania, Dr. C. D. Schaeffer, and Dr. R. D. Kennedy were strongly in favor of the properly trained nurse anæsthetist. Dr. Schaeffer said that the nurse anæsthetist should bear the same relation to the surgeon that the technician does to the X-ray or laboratory specialist; that the anæsthetist should be thoroughly acquainted with the patient before starting the anæsthetic and that he should not be relieved of the responsibility until the patient has entirely recovered from the anæsthetic. Dr. Kennedy mentioned the fact that in sparsely settled districts it might be quite impossible to secure a physician anæsthetist and warned against any legislation which would make it illegal for a nurse to give an anæsthetic, as the delay resulting from the difficulty in securing a physician anæsthetist might easily prove fatal to the patient. Dr. Bunts' plea that the nurse be allowed to give a general anæsthetic when advisable was warmly applauded by the majority of the Fellows present.

Dr. John Osborn Polak, of Brooklyn, was asked for his opinion of sacral anæsthesia. He stated that he had only used it a few times in cases of cæsarean section, but was pleased with the lack of any evidence of anæsthesia in the newborn child so often present when ether is used. He has used sacral anæsthesia in all types of pelvic operations, but prefers ether in most cases. He injects about 40 cubic centimeters of 1 per cent novocaine with adrenalin through the foramina into the pericaudal tissues, which produces complete anæsthesia in from 10 to 20 minutes, although at times he finds it necessary to supplement it with gas.

Dr. Boldt stated that he had made a careful study of sacral anæsthesia as used in the various hospitals and found it on the whole to be rather unsatisfactory due to frequent failures and the large amount of solution required.

Dr. A. J. Crowell, of Charlotte, North Carolina, has used sacral anæsthesia exclusively during the last 3 years, in perineal prostatectomies. In 15 to 20 per cent of his cases, he supplements it with gas and in some cases, while peeling the gland from the capsule, he finds it necessary to inject 2 per cent novocaine to block off the sacral plexus. The anæsthesia lasts from 3 to 8 hours, his patients having practically no postoperative shock.

Dr. John F. Barnhill took exception to the large amount of novocaine injected and mentioned a patient who had died suddenly following the injection of 1½ grains of novocaine in 3 cubic centimeters of solution, but qualified this with the remark that death may have been the result of extreme fright rather than from the anæsthetic.

Dr. H. H. Young emphasized the importance of a careful study of local anæsthesia and urged a systematic consideration of the subject by a committee of the American College of Surgeons. He strongly emphasized the danger of operating on frightened patients and mentioned case reports of three or four patients who had died undoubtedly of fright while awaiting their turn to be anæsthetized.

Dr. T. Casey Witherspoon then presented the following: "Resolved that we express ourselves as opposed to any and all legislative enactments which would prohibit the nurse, when qualified, from giving anæsthetics." This was seconded by Dr. Young, discussed by Dr. Brophy and Dr. Grinstead, and passed without a dissenting vote.

Dr. Truman W. Brophy expressed the opinion that while gas might be all right for a short operation, for long-continued work ether is preferable. He stated that surgical shock is much less frequent in children before the age of 3 months than afterward, due to incomplete development of the nervous system.

Dr. James T. Case, of Battle Creek, Michigan, did not think that lumbar anæsthesia produced shock; that 10 cubic centimeters of solution was all that was necessary; and that a fall in blood pressure should not be cause for alarm, for if the blood pressure does fall it can be quickly increased by giving a small amount of laughing gas. In his experience, anæsthesia is practically instantaneous, and

he has found it possible to do intra-abdominal work within 4 minutes of the time of beginning the injection.

Dr. Young asked if the sudden reduction in blood pressure might not increase the danger of emboli in elderly patients. Dr. Case replied that he did not think there was as much danger from this as from the increasingly high blood pressure produced by the use of ether. Dr. John George MacDougall asked if the patient could be placed in the inverted position. Dr. Case answered that so long as the neck was flexed on the chest, the patient's head could be as low as necessary.

THE ACCESSORY AIR SPACES OF THE SKULL

Dr. John F. Barnhill presented a lantern demonstration of the accessory air spaces of the skull. He stated as a preliminary that the main objectives intended would be:

1. To demonstrate the mode of development of these sinuses between the tables of the skull, the full importance of which he believed was not as yet fully appreciated, especially from the surgical standpoint;

2. To demonstrate the influence of the development of these several sinuses on the normal development of the mouth, teeth and face, and especially to prove that obstruction to normal respiration in the infant and child from any cause furnishes the chief reason for malformation of the mouth, irregular teeth, narrow face, and deflected nasal septum;

3. To show the intimate and very extensive surgical relationship of the several sinuses to the dura mater and its contents, and through its relationship, to the cause of meningitis, brain abscess, and sinus thrombosis;

4. To point out the pathways from these air spaces to the general system, through which infection may travel and from which source many local and general diseases undoubtedly arise.

In discussing Dr. Barnhill's address, Dr. Emil G. Beck, of Chicago, referred especially to the possibility of intrathoracic lymph-gland infection from sinuses, tonsils, etc. He had taken stereoroentgenograms of the chests of fifteen apparently healthy nurses and found all to have enlarged intrathoracic lymph nodes.

Dr. W. E. Waddell, of Los Angeles, California, emphasized the fact that a healthy head almost invariably pre-supposes normal intranasal structures and quoted cases of prompt improvement of vision following restoration of ethmoid drainage.

Dr. Frank M. Sulzman, of Troy, New York, made a plea for more exact diagnosis, emphasizing the value of the X-ray and the doubtful value of transillumination. The diagnostic value of position was referred to by Dr. Randolph Winslow, Baltimore, Maryland, while Dr. Brophy called attention to Dr. Schaeffer's investigation which showed that 56 per cent of frontal sinuses empty into the antrum instead of the infundibulum. He made a plea for the conservation of the teeth in the presence of antrum infection, limiting removal to those which are definitely infected.

FRACTURES

On March 6, the subject of "Fractures" was discussed and Dr. E. R. Secord, of Brantford, Ontario, presented his views.

The treatment of fractures is an important subject, not given the attention which it deserves, either in undergraduate or postgraduate studies.

Over 60 per cent of suits for malpractice, and almost 100 per cent of the adverse decisions are based on fracture cases.

Many improvements in methods of treatment have gradually been evolved with which the names of Bardenheuer, Lucas Championere, Lane, Robert Jones, Codivilla, Steinmann, Besley, Pearson, Albee, and Gallie may be associated.

Various methods of treatment of any given fracture may be successfully used by different individuals depending on their experience, environment, available assistance, and apparatus. The results achieved by Pearson and Drummond by direct extension in fractured femurs during the latter years of the war bear evidence to this.

In a general way, most fractures may be successfully treated by combined reduction and retention and indirect fixation, provided sufficient attention and care, including proper roentgenological examination, is given. Certain types of fracture, however, are at times best treated by operative means with some form of internal fixation. It would appear that fractures of both bones of the forearm, at or about the middle, and fractures of the upper third of the femur most frequently are examples of this necessity.

In such types in recent simple fracture the Lane plate is probably the method of choice, and it is unlikely that the proper use of the plate will be followed by the dire consequences that are feared by the advocates of the autogenous bone graft. Following operation, however, any form of internal fixation must be treated with the same support and immobilization which would have been used had operation not been done.

In ununited fractures, autogenous bone grafting is the treatment of choice; but for some unknown reason, possibly because of the chemistry of the body fluids and of bone formation, bone grafting fails because of the absorption of the graft in about 20 per cent of the cases, even under the most favorable circumstances.

Dr. R. D. Kennedy, of Globe, Arizona, emphasized the importance of exact knowledge of the surrounding soft parts in the management of fractures. He was of the opinion that regardless of the care which is exercised in the treatment of fractures, deformities will sometimes occur. Dr. J. T. Harrington, of Poughkeepsie, New York, in treating fractures of the patella, uses ordinary suture material, having used wire in only one case of secondary fracture.

The question of damage suits as the result of fractures was discussed informally. Dr. Secord stated that 76 out of 124 damage suits were fracture cases, and that the only suits lost by the defendant were fracture cases.

TENDON TRANSPLANTATION IN THE FOREARM

Dr. R. D. Kennedy, of Globe, Arizona made the following remarks on "Tendon Transplantation in the Forearm":

Tendon transplantation is done in the forearm following irreparable injuries to the musculospiral or posterior interosseus nerves, or such extensive destruction of the muscle tissue of the extensor muscles as to render them functionless. If the injury to the musculospiral is above the point where the nerve supply is given off to the extensors of the wrist, it is necessary to transplant the pronator radii teres into the extensors of the wrist. This is done by making an incision about the middle of the radius on the anterior surface, displacing the supinator outward and the nerve and vessels inward and exposing the pronator at its insertion. The tendon is short and flat and it is better to remove it with the periosteum attached. The wrist is dorsiflexed and the extensor tendons exposed. They are pulled up enough to maintain dorsiflexion, and with a sharp scalpel a slit is made in both of them through which is passed the tendon of the pronator. One-half of the extensor tendons is sutured to the pronator using chromic catgut. The sheath is carefully restored to prevent adhesions, and the skin is closed while the assistant maintains the dorsiflexion so as not to put too much strain on the point of transplant. An incision is now made in the skin beginning a little below the middle of the radius passing down well beyond the styloid process across the dorsum of the hand and up along the outer side of the ulna to a point about halfway between the wrist and elbow. The skin flap is carefully dissected back and the tendons exposed. The flexor carpi radialis is separated from the attachment and drawn upward through a small incision over the lower end of the belly of the muscle. From this point a probe is forced through the tissue and the tendon drawn down through the opening made in a straight line to the three extensors of the thumb, where, with the thumb extended, it is transplanted in such a position as to maintain the extension. This transplant is done as already described. Now the extensor carpi ulnaris is divided from its insertion, care being taken not to injure the vessel or nerve which lie quite close to it. It is dissected upward for about 5 inches and brought across the dorsum of the hand in a straight line to the common extensors of the fingers into which it is transplanted, as already described.

The skin incision is placed well down on the hand so that the line of tendon suture and skin suture will not superimpose and increase the number of adhesions.

The skin is closed and the hand put up on a cock-up splint which will also maintain the extension of the thumb. At the end of 10 days some passive motion is used. At the end of 3 weeks some active motion. At the end of 5 weeks the splint is discarded except at night, and in 2 months the patient should be freely using the hand.

In discussing Dr. Kennedy's paper, Dr. F. N. G. Starr emphasized the importance of keeping the hand in the position of extreme extension.

Dr. Kennedy in closing the discussion stressed particularly the use of the so-called cock-up splint in his operative cases, the importance of accurate diagnosis, and mentioned the difficulty so frequently encountered in suturing the interosseous nerve.

REMOVAL OF URETERAL STONE BY CYSTOSCOPIC MANIPULATION; DISINTEGRATION OF CYSTIN STONE BY PELVIC LAVAGE AND INTERNAL MEDICATION

Dr. A. J. Crowell, of Charlotte, North Carolina, presented a paper dealing with "The Removal of Ureteral Stone by Cystoscopic Manipulation and the Disintegration of Nephritic Cystin Stone by Pelvic Lavage and Internal Medication," as follows:

I wish to illustrate to you this evening by means of slides, first, a method of removing ureteral stone by cystoscopic manipulation, a method which has been very satisfactory in our experience; and, second, to report briefly the method of disintegrating cystin stone in the kidney by pelvic lavage and internal medication.

The method by which we have succeeded in removing stone from the ureter in about 140 consecutive cases with seven failures, since February, 1915, consists of ureteral anæsthesia and ureteral dilatation. We inject a solution of novocaine, 2 to 5 per cent, into the lumen of the ureter through a ureteral catheter and dilate the ureter by means of the retention catheter and metallic dilator.

The success of the method is largely dependent upon the extent of bladder and ureteral anæsthesia. To obtain this, 1 or 2 ounces of the above mentioned solution is injected into the bladder through the urethra and retained for 10 to 15 minutes before filling the bladder with boric acid solution. (If the patient is very nervous or unduly sensitive, it is probably better to use sacral anæsthesia.) The ureteral catheter is then inserted into the ureter until it meets with resistance. At this time procaine solution is slowly injected through the catheter and allowed to remain for 10 minutes. The catheter can then be passed above the stone without difficulty in most instances and especially is this true if oil is injected during this manipulation. With this technique, we have failed to get by the stone in only three instances, but frequently several attempts have been necessary to succeed.

When the catheter has passed the stone, we are masters of the situation. It can be fastened in and retained almost indefinitely. The presence of the catheter will allow the secretion of the kidney to pass through it as well as to dilate the ureter. In this way

functional activity can be ascertained and decision made as to whether or not the kidney should be removed. If infection be present, or should it occur during the course of treatment, the kidney pelvis can be lavaged with antiseptic or saline solutions.

The rapidity with which the size of the catheter can be increased and the length of time it may be retained depends upon the reaction produced by its presence and the size of the stone. Usually a No. 9 tapered catheter will pass the stone after a No. 6 has been retained for 24 hours. We think it well to remove the catheter after it has been retained for 48 hours. In this way we give time for the reaction produced by the presence of the catheter to subside and to see if the stone will pass without further dilatation. If the ureter is thoroughly anæsthetized before withdrawing the catheter and the kidney pelvis is filled with hot saline solution and sterile oil, the small or medium sized stone will pass into the bladder in a very short time, certainly if it is one of recent impaction. Should this fail, the dilatation may be continued until two No. 11's and one No. 6 in the male, and three No. 11's in the female are used. This dilatation may be augmented by means of the metallic dilator. The instrument used is of special value in assisting the stone to pass through the bladder wall and out of the ureteral opening.

The simplicity and safety of this method is very evident. It is simple in that any one reasonably skilled in cystoscopy can do the work in his office or hospital with perfect safety, without using a general anæsthetic and without marked suffering on the part of the patient. It is safe because no trauma of consequence is produced, and in addition to the function of the kidney not being inhibited, drainage frequently improves the renal function. In fact, we have seen marked uræmic symptoms clear up rapidly following such drainage.

Fatalities following this work are unnecessary if ordinary precautions are observed in the technique. This cannot be said of the surgical procedures necessary for the removal of the ureteral stone. The fatalities following operation for the relief of ureteral stone range from ½ of 1 per cent to 20 per cent. From 40 to 60 per cent of the cases applying for relief of this condition have been operated upon with no record of an effort having been made to remove them by cystoscopic means prior to our report of this work in 1921. Some claim that 90 to 95 per cent of these stones will pass spontaneously. If this be true, it is evident that we have been operating upon far too many cases for the relief of this condition.

We do not use this method in children where the urethra is too small to admit a catheterizing cystoscope or in men with enlarged prostates or other conditions, such as bladder tumor, stone, etc., making ureteral catheterization impractical. Of course, it is not applicable in cases of anuria or where the kidney's function has been destroyed by infection.

I will now discuss our method of disintegrating cystin stones in the kidney under pelvic lavage with alkaline solutions, thus rendering and keeping the urine strongly alkaline. We used in our case for pelvic lavage a 1 per cent solution of mercurochrome and gave bicarbonate of soda to alkalinize the urine. Just what part the mercurochrome played, other than to get rid of the virulent infection, I cannot say, but we do know that the solution is alkaline and very penetrating.

Cystin nephrolithiasis is a rare but a very interesting condition. It is interesting, first, because of the uncertainty of its etiology; second, because of the probable infrequent recognition of the disease; and, third, because of the excellent results which may be obtained by proper diet, pelvic lavage, and internal medication. The disease has been known for more than one hundred years. Link was able, in 1912, to collect from the literature only 146 cases. To our knowledge, we have had only one case at our clinic. We probably have had others but did not recognize the condition.

A great many theories have been presented, and considerable laboratory work done in connection with clinical observations in order to arrive at a satisfactory explanation of cystinuria, but thus far we are still far from it.

All agree, however, that since cystin is soluble in alkaline solutions, a very important part of the treatment is to render the urine alkaline and keep it so. The lower the protein intake, the easier this will be to accomplish. We took advantage of this knowledge and used it with great success in our case.

Dr. H. H. Young, of Baltimore, Maryland, congratulated Dr. Crowell on his success in removing calculi through dilated ureters and mentioned that some 250 years ago chemical methods were employed in attempting to dissolve ureteral and renal stones. Waters from certain mineral springs seemed to be beneficial at times. Stones may be fractured by changing the chemical reaction of the urine. As stones frequently occur after an operation, he felt that the question of prevention was of great importance, and thought very favorably of disintegration for this reason. He mentioned that while novocaine aids dilation of the ureters, morphine has a tendency to contract the ureteral muscle fibers. He also stated that fulguration was sometimes very helpful in delivering stones from the visceral end of the ureter.

Dr. J. W. Riley, of Oklahoma City, Oklahoma, thought that sterile water, oils, etc., were about as useful as chemical agents as most stones are discharged spontaneously, and Dr. G. A. B. Addy, St. John, New Brunswick, said that he treated all cases surgically, as he thought that instrumentation was more harmful. He spoke of plugging the visceral orifice of the ureter with "sea tangle," dilating the ureter by back pressure.

Dr. Crowell, in closing, stated he used 1 per cent mercurochrome in the pelvis of the kidney with normal salt solution. All solutions must be warm.

Replying to an inquiry from Dr. Polak he stated that the catheter may be left in the ureter as long as necessary, 36 to 48 hours, if the kidney is kept clean. He has had no bad results from instrumentation and thinks that 95 per cent of the stones can be passed without operative procedure. This being the case, the patient should not be subjected to the danger of an operation.

THE PATHOLOGICAL BLADDER AND POSTERIOR URETHRA

On March 26, Dr. J. U. Reeves, of Mobile, Alabama, presented a very interesting lecture on "The Pathological Bladder and Posterior Urethra— A Cysto-Urethroscopic Study." The lecture was given for the purpose of illustrating this procedure to the man who is doing the work as a matter of routine, and to show just what the cystoscopist is doing or trying to do with genito-urinary conditions. He first exhibited a sagittal section showing the cystoscope in place within the bladder and then within the posterior urethra, followed by numerous color plates showing the normal bladder and urethra; the various bladder tumors with the method of fulguration; vesical calculi, single, multiple and intradiverticular; stones within the ureteral orifice, and those within the ureter causing a bulging within the bladder; conditions of the posterior urethra; papilloma; old protastatic abscesses; the ejaculatory ducts; and pathological conditions of the colliculus. There was no discussion.

OBESITY—CAUSES AND TREATMENT

On March 27, Dr. C. Lee Graber, of Cleveland, Ohio, discussed the subject of "Obesity, Its Cause and Rational Treatment":

Obesity, for the purpose of this discussion, is defined as an increased deposit of general bodily fat in such amount as to interfere with proper function. It is a subject much neglected by physicians and surgeons alike in spite of the fact that it is of great importance in many instances. Its cause has been erroneously attributed to overeating and underexercise. As evidence that these supposed causes are not the etiological factors in the majority of cases, the following is submitted.

1. Fat people, as a rule, eat less than others. This is a matter of common observation.

2. The obese, because of being compelled continuously to carry about their exceedingly burdensome weight of superabundant fat are already working their hearts and skeletal muscles far in excess of normal exercise.

3. Carefully taken histories of these cases show in the great majority of instances, that the taking on of increased weight began with some crisis or other special incident: an attack of typhoid, sudden cessation of menstruation; an operation, not necessarily on the genitals; the birth of a child; marriage; the onset of puberty; the menopause, etc.

The foregoing should cause one to seek further for the etiology. The most plausible cause suggested is that of endocrine dysfunction. As yet no one has demonstrated satisfactorily what endocrines, or combinations of them, if any, are at fault.

Empirical practice, however, has demonstrated without a doubt the efficiency of treatment directed along this line. In the writer's experience, covering a great many cases over a period of 18 or 20 years, the intelligent administration of desiccated thyroid has proved remarkably efficient in the great majority of cases. Occasionally, in women, it has been combined with ovarian substance.

The physician should always dispense it himself, using without change the uniform product of a reliable firm. The dose is from ¼ to 6 grains of the U. S. P. product three times a day. He should weigh his patient every 5 to 7 days until the dose in the given case has been established, aiming to secure an average gradual diminution in weight of ½ pound a week. Overdosage is indicated by symptoms of hyperthyroidism. This all subsides in a few days on discontinuing the medication. Underdosage produces no loss in weight. No special attention need be paid to exercise or diet. Hypertension, cardiac and renal disease are not contra-indications to treatment.

Dr. Polak, in opening the discussion, said that he felt that as obesity has a harmful influence on the progress of operative cases, it should be reduced if possible.

Dr. F. E. Bunts thought that obese persons were more liable to gall stones and that obesity was largely hereditary and possibly due to endocrine unbalance. He recommended a book entitled "Eat and Grow Thin" as presenting rational suggestions on this subject.

Dr. J. T. Case, of Battle Creek, Michigan, said he thought that the consideration of calories was of considerable importance. He favors exercise, swimming in cold water, electric sweat baths, etc., but questions the value of thyroid therapy as mentioned by the essayist.

Dr. J. R. Espy, of Trinidad, Colorado, said he thought that the cause of obesity was more or less coincidental and attributed fatness to heredity and exceptionally good epicurean tastes. He agreed with the essayist that while thyroid is helpful in some cases, it is by no means specific, and that very systematic exercise helps some.

Dr. Effie L. Lobdell, of Chicago, thought that oxidation of tissues was the keynote of the control of obesity. She favored diet and the control of calories, with pleasurable exercise. She referred to the dinner pills so popular in days gone by, which were supposed to interfere with digestion of food, and she urged those who are not doing heavy work to eat sparingly.

Dr. Graber, in closing, stated that while he did not claim an endocrine course as specific, he thought that at least it does more than any other one thing. If the patient does not improve on thyroid alone, ovarian extract is added. He was not very optimistic as to the result of diet, and stated in answer to

questions that the treatment should be kept up as long as the patient lives or obesity continues.

MORTALITY IN CÆSAREAN SECTION

On April 2, Dr. J. O. Polak, of Brooklyn, New York, presented the subject of "Why the Mortality Following Cæsarean Section is Higher than that Following Other Elective Abdominal Procedures."

Incidence of cæsarean section: Hopkins, 1 in 110 labors, 20,000 cases; Long Island, 1 in 120 labors, 5,000 cases.

Potter of Buffalo: 1 in 14, 1921 series; 1 in 11, 1922 series.

While cæsarean section is the easiest way to deliver the baby and, everything favorable, the surest way to secure a live baby, it is not free from danger to the mother. All obstetricians know it is used too freely. If this is true, then what are the accepted indications? Roughly we divide them into—

A. Absolute: in pelves below 7 centimeters, where other means are impractical, and in cancer of the cervix.

B. Relative: misfits—after a test of labor. Here the fault may be in the pelvis, the child, or the soft parts.

Border-line conditions should always be given a test of labor, except in old primiparæ; as 81 per cent come through spontaneously but this test should be properly conducted. The mechanism of labor never begins in misfits until the cervix is fully dilated. Hence the patient should be given at least an hour's hard pain in the second stage, aided by posture, and a light abdominal binder. But you say if we do this how can we conserve the woman's strength and protect her from infection. (1) By rest with morphine and scopolamine; (2) by nourishment; (3) by conservation of the membranes; and (4) by avoidance of vaginal examination.

Other relative indications are: certain cases of central placenta prævia, which are clean and without severe blood loss; eclampsia but more particularly in the pre-eclamptic stage; endocarditis, where a break has occurred during pregnancy and compensation has been re-established; undilated soft parts after extensive plastic operations; prolapse of cord at term in old primiparæ with membranes ruptured and cervix unprepared; dystocia from previous retroversion operations; some complicating tumors incarcerated in the pelvis, as ovarian cysts and occasionally for obstruction from fibroid in the lower segment; accidental separation or abruptio placentæ when the hæmorrhage cannot be controlled by conservative measure; and rupture of the uterus.

Cæsareans may be divided into the clean suspect and frankly infected cases. Time during which patient has been in labor influences result. Never let a uterus tire for it predisposes to atony.

Selection of operation; classical, transperitoneal, cœliohysterectomy.

Cause of infection: bacteria are always present after 5 days.

Technique. A low incision is used because fundal scars are dangerous.

The uterus is not eventrated and the incision is limited by two guy sutures placed in uterine wall about 6 inches apart.

Hæmorrhage is controlled and retraction secured by means of ergot and intra-uterine pack. The wound is sutured and peritonealization is done.

Conclusion: Section is more dangerous than other clean, elective abdominal procedures—because prenatal work is not routine, interpartum care casual, and there are pathogenic bacteria present in every uterus before the end of the first week.

The discussion was opened by Dr. H. J. Boldt, of New York, who advised against the abuse of cæsarean section and mentioned the case of a child which was born naturally after all preparation had been made for cæsarean section but before the operation could be performed. He strongly urged that cases with severe cardiac conditions requiring cæsarean section should have a sterilization operation at the same time. He did not feel that pelvic tumors were necessarily a sufficient cause for cæsarean section, as they are frequently pulled up out of the pelvis before the beginning of labor.

Dr. J. W. Andrews, of Mankato, Wisconsin, congratulated the essayist on his conservative attitude with reference to cæsarean section and with Dr. J. L. Stevens, of Mansfield, Ohio, asked further information about intra-uterine packing.

Dr. Juan Pou Orfila, Montevideo, Uruguay, S. A., was asked by the chairman to present the attitude of the South American surgeons with reference to the subject. Dr. Pou Orfila, congratulated the essayist on his paper and said that he felt that cæsarean section was not technically difficult and that its principal danger lay in the fact that the condition of the patient was poor, because of the physiological relation of the entire organism to the uterus and its functions. He emphasized two things: first, the probability of existing latent local infection in the cervix, and, second, the enormous hypertrophy not only of the myometrium but of the arteries, veins, and lymphatic vessels, all of which magnified the surface exposed for absorption and prepared for the increased danger of infection and hæmorrhage. He also emphasized the lower resistance of the patient, and the possibility of renal and hepatic insufficiency. General metabolism is frequently disturbed near the end of gestation, which may be due to placental toxæmia. In closing, he said he felt that the prognosis in cæsarean section depended on the association of two principal groups of pathological factors: genital and general, and he outlined his conclusions as follows:

First, as to indications, we must attempt to limit the practice of cæsarean section to those cases which, for instance, show pelvicocephalic disproportion greater than 2 centimeters; if the disproportion is less we should do instead the subcutaneous symphysiotomy of Frank, which is so simple and gives such good results.

Second, from the local point of view, we must give careful attention (a) to the vigorous preparation of the genital canal, both by asepsis and antisepsis, (irrigations of lactic acid 5:1000 solution); and (b) to the systematic employment before operation of hypodermic injections of pituitrin and sometimes of adrenalin. We have also frequently used with good results in our clinic as a substitute for ergotin, the new preparation of Bayer, tenosin, which has the advantage of being more rapid.

Third, from the general point of view, we must give attention to the pre-operative preparation and postoperative care of the patient, employing dietetic measures, elimination measures; neurotherapy and psychotherapy; endocrinotherapy, single and pluriglandular; and such other therapeutic and hygienic methods as may seem indicated.

Fourth, from the technical point of view, we are convinced of the advantages of the low incision, the only one we use, and we employ either the intraperitoneal or extraperitoneal, depending on the case.

Questions by Drs. Henderson, Stevens, and Kickland were answered by Dr. Polak in closing. In the case of an abdominal gunshot wound requiring abdominal section, he would advise not disturbing the pregnancy. He feels that section should not be resorted to in primipara even of advanced years without a preliminary attempt at labor, and in any case, the circumstances should be explained carefully to responsible relatives. He re-emphasized the value of the low incision, as it might not be necessary to do a second section. In packing, he uses gauze in the uterus but not in the cervix. In this way, the uterus contracts and helps to occlude the placental site; bladder peritoneum is used to cover the wound, as is done in hysterectomy.

INGUINAL HERNIA

On April 4 Dr. George Earl, of St. Paul, Minnesota, presented an illustrated lecture on "Inguinal Hernia."

Inguinal hernia is infrequent in animals on all fours. Occasionally it occurs in the pig, ram, and stallion, and then during copulation when the animal tends toward an upright position. It is significant that the human first creeps on all fours when the inguinal canal is oblique or horizontal. With the erect position the canal becomes vertical or nearly so, visceroptosis follows, and the mesentery is no longer able to hold the bowel and omentum away from the open ring. Strain of the diaphragm is a factor. Birds do not have a diaphragm and hence with them sudden or heavy internal force has greater room for distribution.

In making the incision and in suturing one should avoid the ileo-inguinal and ileo-hypogastric nerves, or sensory disturbances will follow. Injury usually comes at the time of incising the external oblique. The fascia should be freed and elevated, and the incision begun away from the external ring, working toward that structure.

The region of the internal ring is relatively of less importance. If the sac is properly dissected from the cord, there is usually no difficulty. If there is a recurrence, it is usually small and gives no symptoms. Torek's technique in working about the internal ring is a contribution of value. Where the cord from below and the vessels from above meet, the protrusion of the sac marks an indirect hernia, the sac then turning to an anterior position as it extends downward. After separating the vessels from the cord and both from the sac, I have the habit of opening the sac. From this point of vantage one can determine the extent of the sac downward, examine for the presence of a complicating direct hernia, and palpate the position of the bladder. In the direct type the bladder not infrequently herniates widely and exact knowledge is requisite both for dissection and suture.

Femoral hernia is another complication of inguinal hernia. While this coincidence is perhaps more common in women, it must always be thought of in men. If not occasionally men will return complaining of recurrence. Examination soon discloses the presence of a femoral hernia but it is difficult to explain this to the patient. It is not unlikely that the femoral hernia was overlooked at the time of the operation for inguinal hernia.

It is in the region subject to direct hernia and of the external ring that failures are most apt to occur. It is over this region that we have had our Bassini and Ferguson arguments. I believe that in every case the cord and vessels should be transplanted completely as far as the deep fascia and muscles are concerned leaving the cord covered only by the superficial fascia, fat, and skin. This procedure is not uncommonly advocated in difficult cases where there is congenital or atrophied absence of tissue in the lower portion of the inguinal canal, and where the operator fears the recurrence of a direct hernia. Here all possible tissue is desired to close in the defect. While all of the external oblique has thus often been placed below the cord in special cases, I have never seen it advocated as a routine measure in all inguinal hernias or at least up to 2 years ago when I reviewed the literature.

Technically, complete transplantation, as I call it, is the simplest procedure. No thought need be given to pressure on the cord or vessels and resultant congestion or to the formation of an external ring from rather rigid tissue as the external oblique. No part of the external oblique is needed as a covering. The cord is not sensitive as is the testicle or liable to injury as is the epididymis. When the cord passes over the pubis, it has even less covering and that against a hard background.

I think I am safe in saying that since the days of Bassini and, in spite of notable exceptions, the tendency of accumulated experience has been toward more radical transplantation. I quote from Halsted, *Annals of Surgery*, 1919, July: "When I first transplanted the rectus in order to suture it to Poupart's ligament and thus strengthened the defect

in the lower angle of the wound due to obliteration of the conjoined tendon, I also transplanted the cord and excised the veins as in the Halsted operation. Since my publication in 1899 we have discontinued transplanting the cord and rarely excise the veins. As far as I have been able to ascertain, in the group in which I had transplanted the cord, there has been only one recurrence, but since the change in technique of leaving the cord undisturbed in the lower angle of the wound, I know of at least four recurrences in operations which I performed myself, and it seems strange that this has made no impression."

Passing to the question of suturing the muscles and fascia we remember that the general action of the muscles of the inguinal region is a backward and upward pull. These muscles have a purchase on Poupart's ligament and the pubic bone. This muscle mass of rectus, internal oblique, and conjoined tendon must be sutured to Poupart's without strain. The common device has been severing the fascia of the rectus near its fusion with the external oblique, beginning at the pubis and extending as far upward as necessary. I am thus routinely freeing the rectus with increasing frequency and for a greater distance, in cases of double herniotomy. Personally I have not seen nor found in the literature any ill effects in the form of weakness of the abdomen at the point of section.

It is perhaps trivial to mention sutures and yet Torek deems it of sufficient importance to discuss. The tissues are placed in an unusual position and undoubtedly there is greater dependence on interrupted than continuous sutures. In case of infection the continuous suture acts as line of least resistance spreading what otherwise nature might wall off.

During the last 5 years I have completely transplanted the cord in every case of inguinal hernia and have come to an almost routine freeing of the rectus. Leaving out the last 12 months and taking the period of the four previous years I have had an opportunity to test this technique in 84 cases, in 21 of which there was a double herniotomy, or a total of 105 inguinal operations. I have heard from all but 4 of these patients. Of course the other surgeon may have seen them, but patients recognize that hernial work is mechanical and as in fracture work they are apt to keep in touch with the doctor. Furthermore if there are to be recurrences they are apt to come very soon. Aside from the rare cases of failure of tissue healing or infection it is not unreasonable to strive to approximate 100 per cent cures in inguinal hernia.

Dr. R. D. Kennedy, in discussion, referred to the prognostic importance of the physical condition of the patient and favored the simple operation for most cases.

Dr. Frank E. Bunts congratulated the essayist and stated that in most cases he does not transplant the cord and favors opening the sac at the internal ring. In cases of true inguinal hernia, he favors transposition of the cord but does not do so in simple cases. He is opposed to operating on a relaxed ring on the opposite side unless very definitely indicated, as it exposes the patient to the possibility of infection and the necessity for re-operation, which is almost always unsatisfactory. He does not favor cutting into the peritoneum and inserting the finger to deliver the sac, as practiced by some operators, as he thinks this adds to the danger of infection.

Dr. Polak emphasized the importance of proper management of the lower end of the wound when operating on inguinal hernia, complicated with femoral hernia.

Dr. Dennis J. Hayes mentioned two cases of testicular atrophy following transposition of the cord. Dr. J. G. MacDougall emphasized the conservation of the nerve supply with attention to the finer details of technique. Secondary pain might be due to incarceration of nerves and secondary atrophy might be due to the same cause. Sutures should not be too tight, and he agreed with Dr. Bunts about unnecessary operating on relaxed ring on the other side. He thought hernia essentially a congenital condition and not due primarily to a relaxed ring. He did not practice transposition as a routine measure and thought it not necessary if the sac is properly tied off and favored operation early in life where indicated.

Dr. T. Casey Witherspoon spoke of the anatomical relations of the sac, showing how a short, tense, conjoined tendon favored the formation of a hernia, while if it was loose, it would act as a preventive. He felt that the so-called potential hernia had practically no significance and that most hernias were essentially congenital.

Dr. J. R. Espey was of the opinion that an operation on one side tended to weaken the other and might be the cause of hernia in predisposed cases. He also favored the congenital idea which, if present on one side, was more than likely to be on the other. He thought femoral hernia might be the result of inguinal operation in predisposed cases. He did not think transposition of particular importance, but emphasized the conservation of nerve structures.

Dr. J. T. Harrington asked about removing the appendix at the same operation, and Dr. W. A. Rohlf inquired as to the suture material.

Dr. Earl, in closing, opposed the removal of the appendix unless definitely indicated; he uses chromic catgut in the deeper structures and plain in the superficial, and was inclined to think that the atrophy mentioned was more likely caused either by a malposition of fat or to pressure above the internal abdominal ring.

PAIN; ITS SURGICAL SIGNIFICANCE

The subject of pain, its surgical significance, was taken up at the April 6 session and discussed by Dr. J. M. Patton, Omaha, Nebraska assisted by Drs. Barnhill, Kennedy, Sulzman, Smith, Reaves, and Witherspoon. Dr. Patton quoted

the objective of the physician, as given by Hippocrates, as "relief of pain" and "prolonging of human life." He recognized the advantage of specialization but urged the men engaged in general and special surgery to keep sufficiently in touch with their colleagues in all fields of surgery so that they may recognize the progress that is made from time to time and thus give their patients the benefit of surgical progress in all lines. He stated that the purpose of the meeting was to present clearly the character and location of pain secondary to surgical lesions in the respective fields represented so they may be promptly recognized by the surgeon, and the patient advised accordingly. He then called attention to the severe prostrating neuralgic pain of acute glaucoma, often associated with nausea and epigastric pain. Sometimes the ocular discomfort is negligible, or the above symptoms so severe as to cause the patient and the physician to disregard the eye until it is beyond hope of recovery. A beginning iritis may be mistaken for a conjunctivitis, until pain, worse in the after part of the night, confirms the diagnosis. If the eye is tender on palpation, a complicating cyclitis is almost sure to be present. Soreness on rotating the eyeball suggests tenonitis and should institute a search for foci of infection. Headaches and eye aches, coming on after use of the eye are easily localized, but the postural pain in the back of the neck and between the shoulders is not so easily recognized, and careful examination of refraction and muscle balance should be made if pain of this nature is not otherwise accounted for.

Dr. J. F. Barnhill, of Indianapolis, discussed pain due to lesions of the intracranial structures.

Pain in the head due to intracranial infections is called headache. Headaches are one of the most prominent complaints and one of the most difficult problems. When pain is dull and recurring, it is most characteristic of pressure; when piercing, of inflammation and pressure. Tumors of the brain of all kinds cause pressure headaches which are very persistent. What is the origin of this pain? The only sensitive structure in the cranium is the dura mater which is supplied by fibers of the fifth nerve. It is very sensitive to pulling and pushing, but not to cuts or injury. Suddenness of pressure has much to do with pain. Acute pain results from rapid transfusion of fluids into the ventricles or subdurally.

Position of the tumor has more influence on pain than size. If tumors are centrally situated there is a cushion of brain substance between them and the dura; hence there may be little pain. On the other hand, a small tumor may block the entrance to a ventricle and cause back pressure. In inflammatory cases there is always pain due to large fluid exudate and pressure combined with inflammation.

Tumors of the hypotphysis are accompanied by pain and a gradual onset of blindness.

Gasserian ganglion pain is recorded as being without the skull; but all information shows that the disease is really in the ganglion.

Dr. Kennedy: Pain in the joints and back:

1. Pain felt on the dorsum of the foot is frequently due to the falling of the anterior arch of the foot. This is increased by standing and one feels as if a nerve were being pinched in the foot. Diagnostic point: if one elevates the arch of the foot he finds the patient unable to flex the toes.

2. Pain in the calf of the leg frequently due to falling of the posterior arch. Bending of foot inward increases the pain.

3. Pain in the knee may be due to hip-joint disease or dislocation of the cartillage. If internal, the knee becomes locked and pain is on the inside. If external, the joint is not locked and the pain is external.

4. Hip-joint disease, accompanied by a limp, causes pain in the hip joint.

5. Pain in the back. There are many causes: focal infection, elongation of process of last lumbar vertebra; adhesion of muscle to muscle sheaths; or strains of cervicodorsal joints. A patient who holds the lower four lumbar joints rigid and has pain on bending probably has muscular adhesions. This is the reason for the success of the chiropractor with these cases. In women we may have postural pain due to lordosis from wearing high heels.

Dr. Sulzman: In the case of a patient with pain in the ear how can we determine the seat of lesion?

If in the examination the patient endeavors to move away when the auricle is touched, pain is constant and worse when the mouth is opened and closed, the lesion is in the external canal and the diagnosis is acute otitis externa.

If no pain is noticed when the finger is pressed gently over the mastoid, but pain is present upon pressure up and inward under the lobe of the ear(the pain itself being either constant or intermittent) the trouble is in the middle ear. Mastoid pain varies with the type of bone which is being dealt with. The pneumatic or ebony type will each have special symptoms.

In the pneumatic type the pain on pressure may be great but the patient will complain very little as the pus has found an easy passage toward the cortex.

In the ebony type the patient complains of much pain, and pressure will not reveal it until later in the course of the disease.

Still another type of pain about the mastoid may become apparent. Pain is brought about by pressure. Examination of the canal and middle ear show no true ear involvement. An otalgia might be dealt with and the foci of infection must be looked for in the tonsils or teeth or other parts of the body. A mastoid operation is unnecessary.

Pain between the eyes, worse when stooping over, constant or intermittent, coming on in some regularly and leaving after a regular period indicates a serious condition. When pus is present the discharge and other pain symptoms are an aid.

Pain in swallowing and difficulty in opening the mouth are indications of quinsy. Pain in swallowing

and ability to open the mouth may be considered an acute follicular tonsillitis, foreign body, or retropharyngeal abscess. Pain in swallowing with or without the pressure of cough or loss in weight usually indicates a condition about the larynx, foreign body, tuberculosis, syphilis or a neoplasm. A further careful examination, history taking, and proper laboratory examination will clear up any question as to diagnosis.

Dr. R. R. Smith: As a rule pain in distal regions of the body is not due to gynecological affections. Pain in the back is rarely due to pelvic troubles. Pain of acute pelvic trouble, as ectopic, infected tube, etc., is rather characteristic. Benign neoplasms of the pelvis do not usually cause pain unless complicated, as with fibroids when efforts at expulsion are made. Malignant tumors are painful only in the later stage. Chronic inflammatory disease may cause pain in the lower abdomen, groin, or genitals. Simple malpositions and simple laceration give little pain or symptoms. Discomfort and pain are usually due to other causes. A large subinvoluted uterus or one in malposition with inflammation may cause pain and discomfort. Prolapse causes discomfort increasing with years. If there is nothing definitely pathological in the pelvis, beware of locating seat of pain there.

Dr. J. U. Reaves, of Mobile, Alabama: Tenderness upon pressure is apparent in inflammatory conditions of the kidney, either acute or chronic. Normally the kidney, which is located wholly beneath the ribs, is not perceptible to palpation, as the kidney may be felt only in the presence of undue renal mobility or enlargement.

If spontaneous pain in the kidney region is complained of by the patient, examination will reveal that the points of tenderness are situated over the kidney posteriorly, and over the ureter anteriorly. The two posterior painful points over the kidney will be at the costovertebral angle, and where the tenth rib joins the sacrolumbar muscles. The anterior painful points will be at the costorectus junction, at the lateral border of the rectus, lateral to the umbilicus, and at a point midway between the umbilicus and the pubes at the outer border of the rectus. This point may also be located by a line drawn between the two anterior superior spines on the ilia at the outer border of the rectus muscle, over the point where the ureters cross the brim of the pelvis as they enter. Another painful spot most frequently caused by impacted stone in the ureter is in the inguinal region at the external opening of the inguinal canal and refers downward to the testicle and upward and outward over the crest of the ilium to the lumbar region. It must be remembered that kidney pain is sometimes complained of on the side opposite from the location of the involvement.

Remote points of tenderness are the supra-intraspinous point located just above and within the anterior superior spine of the ilium. Pressure upon this point is exerted upon the external cutaneous nerve and points reflexly to a disordered condition of the kidney. This point is considered by Pasteau to be the most constant of all points of renal tenderness: the lateral supra-iliac point, situated 1 centimeter above the crest of the ilium and corresponds to the point of issue of the perforating branch of the last intercostal nerve. Pain is also referred down the center of the thigh on the affected side. As the sympathetic nervous system supplies all hollow organs and tubes, the genito-urinary organs come in for a good supply of sympathetic nerve fibers, and excrutiating pain of the genito-urinary organs, from any cause, produces vomiting reflexly through the solar plexus. This nausea and vomiting are common symptoms associated with severe pain in the genito-urinary tract.

Bladder pain is located behind the pubes or supra pubically and is referred down the urethra its entire length, and posteriorly to the lumbar region.

Pain at the beginning of micturition, in the anterior urethra, especially in the fossa navicularis, is of the anterior urethra; this same pain at the end of micturition is a referred pain from the posterior urethra. Deep pain at the end of micturition is either of the prostate or seminal vesicles.

Pain caused by conditions in the prostate is centered around the anus and perineum, but is referred to the lower lumbar and upper sacral region. This also applies to pain originating from the seminal vesicles. The adjacent involvement of the posterior urethra in these conditions is referred down the urethra to the fossa navicularis. Involvement of Cowper's gland causes pain at the scrotoperineal junction and is referred down the urethra.

Pain in the vas is first felt at the internal inguinal ring, and radiates with the disease to the epididymis. Testicular pain centers over the testes involved, and is referred up the cord, over the crest of the ilium to the lumbar region and through the sympathetic system to the stomach.

In conclusion I wish to state, that pain is not the most dreaded symptom in genito-urinary diseases, but that of a hæmaturia which is symptomless. In all cases of hæmaturia the patient should be urged to consult a cystoscopist at once for a diagnosis, while the hæmaturia is still present so the bleeding point can be easily detected and a diagnosis made of whatever condition is causing the hæmaturia. This point cannot be emphasized too strongly. In cancer of the kidney, hæmaturia may appear early and be the only symptom. This is also true of cancer of the bladder and adnexa. In renal calculus, hæmaturia often appears abruptly and without any previous attack of pain. Pain is not always a prominent feature of kidney stone, for some stones produce absolutely no pain.

Dr. Witherspoon: Pains in the chest and upper abdominal region, are fundamentally divided into visceral wall and nerve pain. The nerve supply corresponds largely to the segmentation of the cord.

Pain should be diagnosed as to source, whether visceral, somatic, or central. Pain in the upper

abdomen naturally refers to the viscera, gall bladder, etc. Viscera are not sensitive to touch or injury. Visceral pain is located in the soma, supplied by the same vertebra segment which supplies the viscus; but the pain may be referred to the opposite side or transposed vertically. Pain in the pleura may be referred to the abdominal wall because of the dorsal nerves which go to the abdominal wall.

Dr. Beck: Pain should be relieved; but when it is of diagnostic value not until diagnosis is made.

SURGICAL PROCEDURES IN NON-PERFORATING PYLORIC ULCERS

On April 9, Dr. T. C. Witherspoon, of Butte, Montana, presented a paper on "Surgical Procedures in Non-Perforating Pyloric Ulcers":

Non-blocking ulcer or ulcer scar of the stomach is not a surgical disease of itself. This lesion should be treated by the internist with some well-directed measure. It is only in cases of perforation, repeated hæmorrhage, unyielding pain or symptoms, and suspected malignancy that direct operative measures are indicated. Lesser operative procedures, remote from the lesion, are indicated whenever a focal infection is found which might have been instrumental in ulcer development. Tonsils and teeth are especially to be questioned.

Attention is especially directed to the usefulness of a suprapubic drain after closure of a stomach or duodenal perforation. While the infection of the peritoneum is mild in these cases, it is well to provide a low drain in all such conditions.

Gastro-enterostomy and pyloroplasty are done fundamentally for bettering stomach drainage. They are indicated in mechanical block at the pylorus. Of the two procedures, gastro-enterostomy is safer, more easily performed as a rule, insures better stomach drain, and is usually the operation of choice. If adhesions form about the stomach wound they are harmless following gastro-enterostomy, but often symptom-producing after pyloroplasty. Pyloroplasty simply maintains a physiological route but in case of duodenal ulcer, there is no relief from food traumatizing or chemical irritation of the ulcer.

In simple perforation of stomach or duodenum where no pyloric block exists, there is no indication for gastro enterostomy as supplementary to the closure of the ulcer. This would only entail a prolonged operation, an irritation of handled viscera and an increased danger from spread of infection.

Removal of an ulcer area is good surgery whether gastro-enterostomy or pyloroplasty is done.

Dr. W. A. Kickland opened the discussion. He mentioned eight cases of acute perforation, in which one patient with pyloroplasty died and one recovered after a secondary operation for subphrenic abscess. Six cases of gastro-enterostomy resulted in satisfactory recoveries.

Dr. F. N. G. Starr thought the procedure depended on the type of ulcer. In the case of an acute perforation, he advised sewing up and locating the focus of infection. Where induration is present, he advised gastro-enterostomy, and if there is no perforation, he advised against drainage.

Dr. Juan Pou Orfila preferred gastro-enterostomy if the condition of the patient permits.

Dr. Earl thought a definite ulcer should be excised and, in suitable cases, felt that pyloroplasty was safer than gastro-enterostomy. He called attention to the fact that obstruction of the distal end of the duodenum may be the cause of the ulcer and at times may require duodenal enterostomy.

Dr. R. M. Howard expressed the belief that the non-obstructive ulcer is the difficult problem, and that gastric ulcers are worse than those of the duodenal type and not so easily relieved by gastro-enterostomy. He favored cauterization as well as excision and stated that careful diet and management are of the greatest importance.

Dr. Emil Beck favored excision whenever possible and advised gastro-enterostomy when much induration was present.

Dr. L. H. Hamilton called attention to the duodenal end, urging thorough examination, especially of the distal third, and with Dr. Earl, favored duodenal anastomosis.

In closing, Dr. Witherspoon restated that it was usually the small, round, acute ulcers that perforated. He did not advise pyloroplasty in the usual case; favored median abdominal drainage, if at all indicated; and urged a very careful and thorough closure of the ulcer.

EXAMINATION, DIAGNOSIS, AND TREATMENT OF RECTAL DISEASES

Dr. F. E. David, of Chicago, presented a paper on "Examination, Diagnosis, and Treatment of Some Rectal Diseases": If we wish to have the opportunity to cure more cases of carcinoma of the rectum, we must so perfect our technique in the minor troubles that patients will not fear to consult the surgeon.

As in other diseases the written history is necessary. In writing the history the important points to consider are:

1. History—(a) Age; (b) Duration of symptoms (c) Protrusion—character, time of occurrence, recurrence; (d) Hæmorrhage (as above); (e) Discharge; (f) Pain—character, time constant, intermittent.

2. Symptomatology—(a) Fissure; (b) Irritable ulcer; (c) Hæmorrhoids; (d) Carcinoma; (e) Perirectal abscess; (f) Fistula; (g) Pruritus ani.

Usually the complications, not hæmorrhoids (except those of acute thrombotic or extremely hæmorrhagic type) cause patients to consult the surgeon; there are comparatively few uncomplicated cases of hæmorrhoids. Hence the necessity for searching for that which, if not found, prevents a cure.

3. Examination—left lateral position.

4. Instruments for examination—(a) Small conical speculum; (b) proctoscope; (c) probes; flexible,

small diameter, straight, and reverse, in examination of fistula.

5. Preparations for operation.

6. Selection of anæsthetic—Gas, oxygen or gas, ether in deep perirectal abscess. Local anæsthesia in 90 to 95 per cent of other cases. Why?

7. Technique of operation in—(a) Fissure; (b) Ulcer; (c) Hæmorrhoids; (d) Perirectal abscess; (e) Fistula; (f) Pruritis ani.

8. Postoperative treatment.

DEEP ROENTGEN AND RADIUM THERAPY

Dr. James T. Case, of Battle Creek, Michigan, gave an excellent talk on the present status of deep roentgen and radium therapy in which he called attention to the very recent advances in our knowledge of roentgentherapy, especially during the last five years. He deplored the tendency of medical men to acquire their knowledge of X-ray technique from traveling salesmen and urged a careful study of the subject from reliable sources. He emphasized the importance of accurate measurement of dosage by means of the electroscope and believed that radium was more useful for the deeper structures, uterus, etc., and the X-ray better adapted for superficial work. He then systematically considered the following points:

1. The law of the inverse square. For example, it requires eight times longer to produce the same dosage at 8 centimeters than at 4 centimeters.

2. Penetration of the X-ray depends on the voltage, diagnosis requiring from 60 to 85 kilo-volts while treatment requires from 50 to 250 kilo-volts. He explained the relative position of X-ray and radium with their various rays and compared the X-ray tube to a battle ship with its various sizes of armament. As the X-ray tube shoots all its batteries at once, the necessity of filters is readily seen. Dr. Case explained the various types of filters and their importance and indication. Under the fourth head, he discussed the question of secondary radiation under which he considered: (a) secondary characteristic; (b) scattering radiation; (c) secondary pale rays. He urged careful planning of dosage in roentgentherapy and considered it of greatest importance.

In discussing radium, the essayist said that in early carcinoma of the cervix the use of radium was perhaps better than surgery, but in order to accomplish satisfactory results, it must be used in large doses. He also urged the importance of accurate clinical diagnosis before applying deep therapy and stated that in certain cases the rays apparently had a harmful effect on the intestinal and gastric functions. He preferred X-ray for cancer of the larynx and œsophagus as he felt that mechanical irritation from the introduction of the radium sometimes did more harm than good. In replying to a question by Dr. Boldt as to the effect of irritative doses of radium in cases of amenorrhœa, Dr. Case did not think it really had much effect either one way or the other on blood conditions.

IMMUNITY AND ITS RELATION TO SURGERY

On April 11, the closing day for the general sessions, Dr. Emil G. Beck, of Chicago, presented a lecture on "Immunity and Its Relation to Surgery":

Every individual when born possesses a slight degree of immunity against all diseases, the so-called inherited immunity. During his life he acquires an additional immunity to such diseases as exist in his surroundings, either by small repeated doses of infection so slight as not to cause even susceptible symptoms or by passing through an attack of a disease. The degree of immunity and its duration vary greatly. An attack of mumps, for instance, immunizes the individual for life time, while measles or typhoid immunize only for a short period. There is as yet no practical way of measuring by chemical or biological test the immunity of an individual against a certain disease. The Shick test or the opsonic index has come nearest to it. Besides this acquired immunity we may produce it artificially, by injection of sera vaccination or by raising the resistance of the individual by treatment, fresh air, rest, feeding, and medication. This is what medical treatment actually does; but at times the patient does not respond to all these measures. He grows worse in spite of all, because the production of antibodies does not keep pace with the rapid work of the invading micro-organisms.

What can surgery do to produce immunity? It can do a great deal and does so in many operations. For convenience of illustration if we represent the degree of immunity of an individual by a number which would approximately indicate the degree of immunity, and also represent by other figures the amount of disease present (make a ledger with a debit and credit account, the disease figure on the debit side and the immunity on the credit side), the difference in the balance will indicate the status of the patients' condition and the comparative proportion between the disease and recuperative power.

Let us illustrate by a case of tuberculosis of the kidney—

Debit		Credit	
Right Kidney	20	Immunity developed	15
Left Kidney	5	Immunity developed	3
Bladder	5	Immunity developed	3
Lung	8	Immunity developed	5
Scattered	5	Immunity developed	3
Total	43	Total	29

Total deficiency of immunity 14.

This patient needs 14 units of immunity substances to overbalance the progress of the disease.

What does the surgeon do to bring it about? He removes the right kidney which changes the figure on the debit side from 43 to 23, while the credit side remains the same. The patient has now six units of immunity to spare. The removal of a large part of the disease releases immunity bodies which can now operate in other regions of the body and attack the ruining disease.

This theory is illustrated in the practice of everyone. You will recall cases in which sinuses were present in many regions of the body and after amputation of the very much diseased limb, the sinuses closed spontaneously and the patient gained rapidly in weight.

When a tuberculous kidney is removed and the bladder is known to be affected also, a rapid improvement is often noted not only in the general condition but also in the bladder.

We have kept track of many cases of this kind and have checked up the findings from time to time, with roentgenogram and have found that the facts fit the theory in almost every instance.

In the discussion, Dr. C. C. Sweet, of Ossining, New York, asked why influenza, instead of producing immunity rather predisposes to another attack. Dr. E. R. Secord stated that, according to records, typhoid fever may recur up to the end of a year but it is not likely to do so after that period; also that children with joint or gland tuberculosis do not, as a rule, develop the pulmonary type of that disease.

Dr. T. H. Culhane, of Rockford, Illinois, referred to the fact that so many apparently healthy soldiers succumbed to influenza in 1918, while their otherwise less healthy companions with less virulent conditions such as measles, asthma, etc., seemed to a certain extent to have immunity to influenza. He mentioned a case of sarcoma that disappeared after a severe attack of measles, and a most intractable case of malaria that cleared entirely after the unfortunate victim almost succeeded in committing suicide by taking illuminating gas.

In closing, Dr. Beck explained that the principle as stated did not apply to Hodgkin's disease, and that as a rule removal of the glands predisposed to more rapid recurrence. It was his opinion that all other diseases produced a certain amount of immunity. He had observed that tubercular joint conditions do not improve on the removal of surgical tubercular lesions elsewhere in the body, and as a rule patients with joint tuberculosis do not have pulmonary tuberculous trouble. He sincerely hoped that some quantitative test for immunity might be developed, because it would be of the utmost value from a surgical standpoint.

CLOSING MESSAGE

BY DR. CHARLES D. SCHAEFFER, CHAIRMAN

We are now reaching the end of our wonderful cruise, so well arranged and prepared for our pleasure and education by the American College of Surgeons. At this moment we have within us a sense of joy mingled with a feeling of regret. We sincerely regret that the ties of friendship formed during this cruise are about to be undone; that they cannot longer continue the same. On the other hand, we rejoice that we have had the exceptional opportunity of enjoying the wonderful advantages of this cruise, so well thought out and executed by one of the greatest American physicians, who heads the College of Surgeons. Each return of this day must of necessity bring to him more flowers and sweeter, more songs and higher, and yet deeper and wiser meditations.

As I am here before you in the closing hour of our frequent meetings, I wish to thank the members of the Committee on Scientific Meetings and the participants in the discussions; especially do I wish to express my appreciation to Dr. Patton for his valuable assistance and co-operation in arranging these programs. As to whether or not these meetings were a success must be left to your judgment. They were always well attended and the papers with their discussions indicated a great interest in the rapid progress of our science. Each one attempted to advance new ideas and methods of operation for the purpose of educating his confrères, that they, in turn, may apply them to relieve suffering humanity. No walk in life can boast of greater progress.

Were a Calvin or a Jonathan Edwards to be recalled to life at this moment, he could discourse to us as learnedly as ever on Predestination and Free Will; a great preacher, a Spurgeon or a Beecher, could at this very moment stir our souls and warm our hearts as of old; a great jurist, a Justinian or a Marshall, could today expound the same principles of law which practically hold good for all time; a great orator, a Webster or a Burke, could this very moment convince us with the same arguments and arouse us with the same invectives which made our forefathers willing captives to silvery tongues; but so great has been the progress in surgery that were a Sam Gross, a Senn, a Fenger, a Cooper, an Agnew or an Ashhurst, all of whom died within our day, now recalled before us, he could not teach modern surgical principles, nor could he perform a modern surgical operation. Our operations on the head, the chest, and the abdomen would cause these men to wonder whether we had not lost our senses.

This progress was largely made possible through the discoveries of that famous English surgeon, Lord Lister; and when the members of the British Medical Association at Montreal, and of the International Convention at Berlin, arose *en masse* and welcomed him with cheer after cheer, it was but a feeble expression of gratitude for a service to humanity which no words can desribe. No fame, no praise, no reward is too great for such men.

The unselfish motive which prompted Lord Lister may well be compared to that of our Director-General, who conceived this cruise in order to spread into foreign countries the principles which underlie this noble institution. We should therefore go to Chicago next October and convince the officials of the College that we stand back of them, and that we propose to encourage this work so that the institution may become the most gigantic factor in the Western Hemisphere for the education of surgeons. Therefore, let us all plan a visit to Chicago next Autumn for a general reunion.

Before adjourning, however, as we all have within us a profound sense of gratitude for what our Director-General has done for us, let us give him a standing vote of thanks.

PENNSYLVANIA, NEW JERSEY, AND DELAWARE; NEW YORK; MARITIME PROVINCES; AND NEW ENGLAND SECTIONAL MEETINGS OF THE CLINICAL CONGRESS

PENNSYLVANIA, NEW JERSEY AND DELAWARE

THE sectional meeting of the Clinical Congress of American College of Surgeons for the states of Pennsylvania, New Jersey, and Delaware was held at Wilkes-Barre, April 30 and May 1. Headquarters and registration rooms were at the Sterling Hotel.

All meetings and clinics were well attended and the programs were received with enthusiasm and interest. The Hospital Meeting and the Round Table Conference were held in the Ball Room of the Sterling Hotel at 2:00 p.m., on the first day and were followed by the meeting of the Fellows, when the election of the State Executives for the ensuing year took place. The following were elected:

Pennsylvania

Chairman—J. L. Atlee, Lancaster
Secretary—S. P. Mengel, Wilkes-Barre
Counselor—J. J. Buchanan, Pittsburgh

New Jersey

Chairman—B. Van D. Hedges, Plainfield
Secretary—George W. Sexsmith, Bayonne
Counselor—James S. Green, Elizabeth

The evening Public Meeting was held in the Irem Temple. This beautiful auditorium, one of the finest in the country, was crowded with an attentive audience. The program which began with an organ recital was promptly carried out. The Scientific Program on the second afternoon was especially interesting. All hospital clinics were well attended and showed careful preparation. Everyone sincerely regretted the absence of Dr. C. D. Schaeffer of Allentown, the State Chairman, who, because of illness, was unable to be present. Dr. L. H. Taylor of Wilkes-Barre very ably took the Chairman's place at the meetings.

To the energetic efforts of Dr. S. P. Mengel and the Local Committee on Arrangements is largely due the splendid success of these meetings.

NEW YORK

THE New York State sectional meeting for 1923 was held in Syracuse May 7 and 8. The Hospital and Scientific Meetings, in the Ball Room of the Onendaga Hotel, were particularly well attended. The Public Meeting was held in the Mispah Auditorium.

At the meeting of the Fellows of the College following the Hospital Conference the state officers were elected for the next year:

Chairman—Edwin M. Stanton, Schenectady
Secretary—Arthur J. Bedell, Albany
Counselor—John O. Polak, Brooklyn

Clinics and surgical demonstrations were held at the local hospitals. As Syracuse is a medical teaching center, it was particularly well equipped for this purpose. The success of the meetings was due to the energetic efforts of Dr. G. M. Price, Dr. F. Flaherty, and the local committee. The thanks of the College is due also to the local press and to many others who ably assisted in carrying on the 1923 Sectional Meeting in Syracuse.

MARITIME PROVINCES

THE 1923 sectional meeting for the Maritime Provinces was held in St. Johns, New Brunswick, on May 11 and 12. Fellows of the College and those interested in hospital work were present and all three provinces were represented. Registration headquarters was at the Royal Hotel. The Hospital Conference and Scientific Meetings were held in the Y. M. C. A. Auditorium.

Dr. Walter W. White presided at all the sessions. There was a good attendance and much interesting discussion. The Public Meeting held in the Centenary Church at night was attended by a large and a very enthusiastic audience interested in better hospitals and better health. The clinics and demonstrations at the hospitals were well prepared and of great interest.

To the efforts of the Local Committee, of which Dr. W. W. White was Chairman, is due the success of these meetings.

The following Maritime Executives were elected for next year:

Chairman—Alexander MacNeill, Summerside, P. E. I.
Secretary—John H. Allingham, St. Johns, N. B.
Counselor—George H. Murphy, Halifax, N. S.

HOSPITAL MEETING, BANGOR, MAINE

ON Sunday evening, May 13, 1923, a large Hospital Meeting was held in the City Hall, Bangor, Maine. The auditorium was crowded. The Mayor and local hospital di-

rectors occupied the stage. Music was supplied by the High School orchestra of 20 pieces.

Addresses were delivered by the Mayor, Dr. M. T. MacEachern, president-elect of the American Hospital Association, Father Thomas F. Nelligan, and Dr. Allan Craig, of Chicago, associate director of the American College of Surgeons. Dr. Daniel McCann presided.

The success of this meeting was largely due to the efforts of Dr. Eugene Sanger and his associates, who have always taken a keen interest in hospital efficiency.

NEW ENGLAND STATES

THE New England States Sectional Meeting of the American College of Surgeons was held in Worcester, Massachusetts, on May 15 and 16. Here was one of the largest, if not the largest, sectional meeting the College has ever had. Both afternoon and evening, the Ball Room of the Bancroft Hotel was crowded by a splendid audience. The Scientific Meeting also drew a large attendance and was full of interesting discussion. The hospital clinics were all well attended. There were 175 registrations.

Dr. Homer Gage was presiding officer, and Dr. Kendall Emerson with the Committee on Arrangements spared no efforts in making the meetings successful and worth while to everyone.

The following State Committees were elected for the coming year:

Massachusetts

Chairman—H. G. Stetson, Greenfield
Secretary—E. L. Hunt, Worcester
Counselor—Frank H. Lahey, Boston

Connecticut

Chairman—Charles C. Godfrey, Bridgeport
Secretary—Samuel C. Harvey, New Haven
Counselor—John B. Boucher, Hartford

Maine

Chairman—William Bradford, Portland
Secretary—Carl Robinson, Portland
Counselor—E.B. Sanger, Bangor

New Hampshire

Chairman—Ira J. Prouty, Keene
Secretary—James W. Jameson, Concord
Counselor—John H. Gleason, Manchester

Vermont

Chairman—E. T. Brown, Burlington
Secretary—W. W. Townsend, Burlington
Counselor—William Stickney, Rutland

Rhode Island

Chairman—John W. Keefe, Providence
Secretary—Frederick V. Hussey, Providence
Counselor—A. T. Jones, Providence

CLINICAL CONGRESS OF AMERICAN COLLEGE OF SURGEONS

THIRTEENTH ANNUAL SESSION, CHICAGO, OCTOBER 22–26, 1923

HARVEY CUSHING, Boston, *President* ALBERT J. OCHSNER, Chicago, *President-Elect*
FRANKLIN H. MARTIN, Chicago, *Director-General*

LOCAL EXECUTIVE COMMITTEE

ALLEN B. KANAVEL, *Chairman*

FREDERIC A. BESLEY
JOHN A. CAVANAUGH
ARTHUR H. CURTIS
CARL B. DAVIS
CHARLES DAVISON
E. K. FINDLAY
GILBERT FITZ-PATRICK
IRA FRANK
HERMAN L. KRETSCHMER
PHILIP KREUSCHER
NELSON M. PERCY
HERBERT A. POTTS

THE thirteenth annual session of the Clinical Congress of the American College of Surgeons will be held in Chicago, beginning Monday, October 22, and ending on Friday, October 26, 1923. The plans for the Chicago meeting, which is the fourth session of the Clinical Congress to be held in this city, conform in a general way to those of recent sessions, the morning and afternoon hours of the four days, Tuesday to Friday inclusive, being devoted to clinical demonstrations in the hospitals and medical schools, and the evenings to scientific programs.

A conference on the hospital standardization program of the College and the many problems related thereto will occupy the morning and afternoon hours on Monday, the program consisting of papers and discussions by surgeons, hospital superintendents, nurses, trustees, and others interested in the conduct of hospitals.

The first formal session of the Congress is the Presidential Meeting to be held in Orchestra Hall on Monday evening, on which occasion the President-Elect, Dr. Albert J. Ochsner, will be inaugurated and deliver the annual address.

The local Committee on Arrangements, composed of representative surgeons of Chicago, is preparing a program of clinics and demonstrations to be given in the hospitals and medical schools during the four days, Tuesday to Friday inclusive, which will completely present the clinical activities of this great medical center. All departments of surgery will be represented therein, including gynecology, obstetrics, orthopedics, urology, surgery of the eye, ear, nose, throat, and mouth, experimental surgery, surgical pathology, roentgenology, etc.

For the scientific meetings to be held in the ballroom of the Congress Hotel on Tuesday, Wednesday, and Thursday evenings a program of papers and discussions dealing with surgical subjects of timely interest is being prepared by the Executive Committee of the Congress. The speakers will include a number of eminent surgeons from Europe and South America together with distinguished surgeons of the United States and Canada.

The eleventh convocation of the American College of Surgeons will be held on Friday evening, when Fellowship in the College will be conferred upon a group of American and Canadian surgeons and honorary Fellowship upon distinguished foreign guests.

General headquarters for the Congress will be established at the Congress Hotel where the ballroom, Florentine, Elizabethan and St. Francis rooms, together with the foyers and other rooms adjacent thereto on the first and second floors, have been reserved for the exclusive use of the Congress. These rooms will be utilized for evening meetings, registration and ticket bureaus, bulletin rooms, etc.

An application for reduced railway rates on account of this meeting is pending with the railway passenger associations and it seems assured

that a substantial reduction in fares will be granted, applying to all portions of the United States and Canada.

CHICAGO HOTELS AND THEIR RATES

While the hotels of Chicago have a large capacity for the entertainment of visitors, it is well for those expecting to attend the Congress to make reservation of hotel accommodations at the earliest possible date. The following hotels are recommended by the local committee:

Hotel	Minimum Rate Single Room With Bath	Without Bath
Atlantic	$3.50	$2.00
Auditorium	5.00	2.50
Blackstone	5.00	4.00
Brevoort	3.00	2.00
Chicago Beach	4.00	3.00
Congress Hotel	4.00	3.00
Cooper-Carlton	3.50	....
Del Prado	2.50	....
Drake	5.00	....
Edgewater Beach	3.00	....
Fort Dearborn	2.45	1.95
Great Northern	3.50	2.50
LaSalle	4.00	2.50
Lexington	3.00	2.00
Morrison	4.00	....
Planters	3.00	2.00
Sherman	3.00	2.00

LIMITED ATTENDANCE—ADVANCE REGISTRATION

Because of the popularity of these annual clinical meetings it has been found necessary in recent years to adopt the plan of limiting attendance. This plan necessitates registration in advance on the part of all who wish to attend. The limit of attendance will be based upon the result of a survey of the amphitheaters, lecture rooms, and laboratories in the several hospitals and medical schools as to their capacity for accommodating visitors. When the limit of attendance has been reached through advance registration no further applications will be accepted, hence the necessity for early registration. It has been our experience that the limit of attendance will be reached several weeks in advance of the meeting.

CLINIC TICKETS

The use of special clinic tickets has proven an efficient means of providing for the distribution of the visiting surgeons among the several clinics and insuring against overcrowding, as the number of tickets issued for any clinic is limited to the capacity of the room in which that clinic is to be given. Attendance at all clinics and demonstrations is controlled by means of such clinic tickets, which are issued at 8 o'clock at headquarters each morning for that day's clinics.

A complete detailed schedule of the day's clinics will be posted on bulletin boards at headquarters during the afternoon of the preceding day. After the program has been so posted, reservations for tickets for the next day's clinics may be filed, the tickets to be issued the following morning at 8 o'clock. A printed program will be issued each morning which will contain the complete clinical program for the day, with announcements of evening sessions and other information.

REGISTRATION FEE

In order that no financial burden may be imposed upon the members of the profession in the city entertaining the Congress, a registration fee of $5.00 is required of each surgeon attending the clinical meeting, such fee providing the funds with which to meet the expenses of conducting the meeting. A formal receipt for the registration fee is issued to each surgeon registering in advance which receipt is to be exchanged for a general admission card upon his registration at headquarters. This card, which is non-transferable, must be presented to secure clinic tickets and for admission to the evening meetings.

Fig. 1. Resected pyloric portion of stomach from Case 1. Walls thickened and five ulcers indicated by arrows.

Gastric Syphilis; a Report of Two Cases Proved Anatomically.
—William A. Brams and Karl A. Meyer.

SURGERY, GYNECOLOGY AND OBSTETRICS

AN INTERNATIONAL MAGAZINE PUBLISHED MONTHLY

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GASTRIC SYPHILIS; A REPORT OF TWO CASES PROVED ANATOMICALLY[1]

BY WILLIAM A. BRAMS, M.D., CHICAGO
Adjunct, Medicine, Michael Reese Hospital; formerly Lieutenant Commander, Medical Corps, U.S.N.
AND
KARL A. MEYER, M.D., CHICAGO
Attending Surgeon, Cook County Hospital

ACQUIRED syphilis of the stomach, anatomically proved, may be considered a rare disease if one is to judge the incidence by the number of reports of such cases in the literature. Thus, we were unable to find more than 14 cases in which the anatomical reports were sufficiently complete to warrant a diagnosis of gastric syphilis. Among those usually accepted as proved syphilis of the stomach are the cases of Flexner (6), Hemmeter and Stokes (11), Fraenkel (8), Curtis (16), Chiari (23), Klebs (66), Cornil and Ranvier (67), Weichselbaum (68), Birch-Hirschfeld (69), Stolper (64), Buday (13), Sparmann (70), and McNee (71).

This rarity may, however, be more apparent than real for the modern methods of specific treatment have undoubtedly cut short the course of tertiary syphilis in the stomach as elsewhere in the body. Another reason may be that the condition may have been mistaken at the operating or postmortem tables for carcinoma or chronic calloused ulcer of the stomach.

This supposition is supported to a certain extent by the fact that the number of cases of gastric syphilis reported and in which the diagnosis was based solely on clinical or serological evidence has been much greater, especially in the past few years. The exact number of such reports cannot be given but a fair estimate would be about 250.

On the other hand, we must not be led into making a diagnosis of gastric syphilis simply because there is a digestive disturbance coexisting with a positive Wassermann or evidence or a history of syphilis elsewhere in the body. Such a coincidence may be purely accidental especially if we consider a verbal statement made by Professor Finger that about 10 per cent of the population of Vienna would give evidence of luetic infection in the form of a positive Wassermann, history or symptoms of lues. This figure may not apply in certain instances but the example is well worth remembering.

It is, therefore, with the view of emphasizing the clinical and anatomical characteristics of gastric syphilis that these two cases of anatomically proved lues of the stomach are reported.

CASE 1. E. G., female, white, age 25, married, was admitted to the Cook County Hospital on July 7, 1922. The patient's family history was negative; she had never been pregnant, and she denied venereal infection. She was well up to about 3 months ago when she began to complain of dyspnœa, palpitation, swelling of the ankles, pain in the chest and abdomen, and marked loss of weight.

[1] Read before the Chicago Surgical Society, April 6, 1923. (For discussion, see p. 240.)

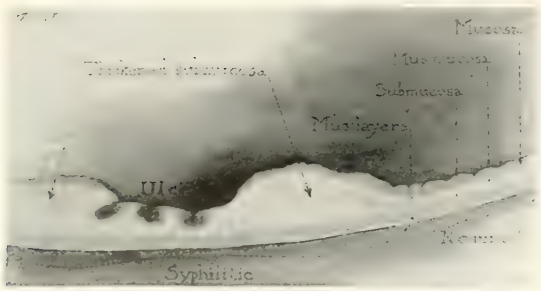


Fig. 2. Cut section of specimen removed from Case 2 showing thick submucosa and shallow ulcer.

The abdominal pain was in the midline, dull or aching, came on about 5 minutes after eating and lasted for about half an hour. Bowel movement had no effect on the pain. The pain soon became more constant but was still worse after meals regardless as to whether she took liquids or solids. Alkalies had no distinct effect and vomiting was the only thing which relieved her. Bodily motion did not increase the pain nor did it radiate in any direction. She lost about 25 pounds in the first 2 months and a good deal more in the following month. She was dizzy at times and frequently had nausea.

Vomiting occurred for the first time about 2 months ago and was chiefly after meals. Large quantities of a bitter, dark brown substance were vomited but never any blood. She also had eructations and belching. She soon noticed that her abdomen became large and that she could induce vomiting by pressing on her epigastrium. She did this to relieve the pain. Anorexia and constipation were also present but there was never any jaundice.

The examination showed a poorly nourished female, very much emaciated and very ill. The pupillary reflexes were normal, and there were signs of a double mitral lesion and aortic insufficiency. The reflexes were normal and the urine contained a trace of albumin and a few hyaline casts. The Wassermann of the blood was strongly positive.

There was a tender bulging in the right hypochondrium, and pressure over this produced vomiting. A sausage-shaped mass was palpated in the epigastrium. Aspiration of the stomach contents caused the bulging to disappear and inflation of the stomach again brought out the tumor.

Examination of the stomach contents after an Ewald meal showed 600 cubic centimeters of residue; free hydrochloric acid 0, total 30; some mucus and occult blood. The stools were tested four times for blood under the usual precautions and with the benzidine test, and were positive in all instances. There was a leucocytosis of 15,100.

X-ray examination showed a large 6-hour residue and no barium had entered the bowel. Only the proximal part of the stomach showed a shadow with a blunt interruption at the pars media. Rotation of the patient to a semi-prone position aided the remainder of the stomach to fill, but the pars media did not fill out even with this change in posture.

Syphilis of the stomach was suspected, but there was also a strong suspicion that the condition might be malignant. She was operated upon for the existing obstruction and for a possible resection of the involved part. About one-third of the stomach was resected, including the entire infiltrated pyloric portion, and a Billroth II operation was performed as there were no adhesions and the adjacent glands were but slightly enlarged. She was also placed on specific treatment. The patient was seen about 2 months after operation. She felt well and had gained 30 pounds.

The anatomical features of this case will be discussed together with those in Case 2, except to point out the differences which were only in degree of the same changes.

Case 2.[1] J. M., male, age 51, married, clerk. Admitted to the Allgemeines Krankenhaus, Vienna on November 26, 1920. Family history negative. Patient had chancre on penis at age of 25 which was treated as syphilis, but for a short time. Digestive disturbances began about 3 years after infection and consisted of burning pains in the epigastrium with radiation upward. The pain came on about an hour and a half after meals and lasted about 4 hours. Occasional pain occurred at midnight and could not be relieved by any measures.

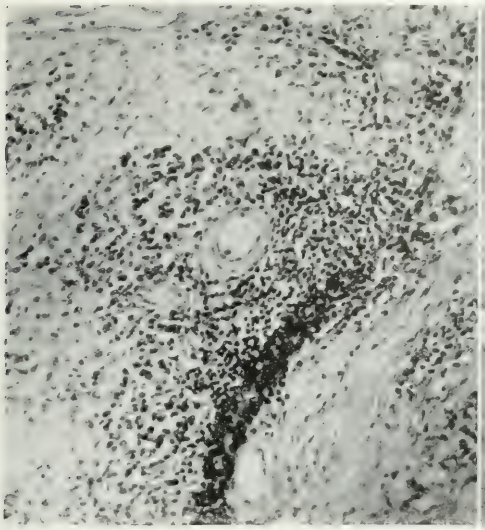
Vomiting was infrequent at first but later occurred daily. The vomitus was about 500 cubic centimeters and contained food but no blood or retained stomach contents. Vomiting was the only thing which relieved the pain in the later stages. Anorexia, constipation, and marked loss of weight were also noted.

Examination showed a markedly emaciated male, no fever, and no abnormal findings in the chest. Ewald test meal, removed 25 minutes after ingestion, showed: quantity, 150 cubic centimeters; free hydrochloric acid 0, total acidity 2; no blood or lactic acid. The abdomen was tender in the upper part but no tumor was palpated. The knee jerks were absent and he had an Argyll-Robertson pupil.

X-ray examination showed a 6-hour residue of about half of the barium meal. The stomach was normal in position, not dilated. There was pyloric insufficiency. The pyloric portion resembled a narrow canal about as thick as a lead pencil and with ragged margins. No tenderness was present at the pylorus or duodenum and the latter had normal outlines. The condition was thought to be carcinoma. The pyloric portion was resected and a Billroth I operation performed.

A Wassermann taken after operation was strongly positive. The stools were examined for blood but the results were indefinite. The diastase content in the serum, urine, and stools was normal, and there was a white count of 29,600.

[1] Reported in Arch. f. Verdauungskr., 1921, xxvii, Sept. 6.



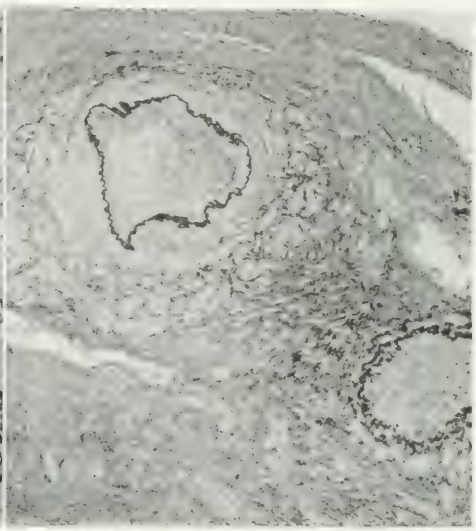


Fig. 3 (at left). Perivascular infiltrate consisting chiefly of lymphocytes and a few plasma cells. Hæmatoxylin-eosin stain.

Fig. 4. Pan-arteritis and pan-phlebitis with complete obliteration of lumen of vein and almost complete obliteration of the arterial lumen. Marked change in the adventitia of the artery. Weigert elastic tissue stain.

The anatomical features of the resected specimens showed the characteristic changes which allowed a strongly presumptive diagnosis to be made at once. These were the *thickened submucosa; shallow, multiple, and irregular ulcers*, and the presence, in Case 2, of visible *miliary gummata*.

The entire pyloric portion of the stomach was thickened and infiltrated. Case 1 showed 5 shallow, irregular ulcers on the anterior and posterior walls, while Case 2 had only 3 such ulcers on the posterior surface. The maximal diameters of the smallest ulcer were 15 by 5 millimeters and 35 by 10 millimeters in the largest. The average depth was 2 millimeters and the comparatively smooth, dark red base stood out in relief against the pale gray surrounding mucosa. The margins were somewhat raised and thickened but there was no necrosis or caseation anywhere.

The cut section showed the submucosa to be thickened to about eight times its normal size in the region of the ulcers and normal beyond them. This layer was pearly gray, of rubbery consistency, and Case 2 showed small pinpoint miliary gummata. At no place in either specimen did the ulcer go deeper than the more superficial part of the submucosa.

Numerous slides were stained with hæmatoxylin-eosin, Weigert, Van Gieson and stains were made for bacteria with Gram and methylene blue, and stains for tuberculosis bacilli were made. The Levaditi method was used in the search for the treponema pallida.

The microscopic examination showed that all of the important changes were chiefly in the submucosa and that the thickening of this layer was due to the connective tissue proliferation, round cell infiltration and œdema. It was the œdema which was the principal factor in the thickening of the submucosa in Case 2.

The chief features seen on microscopical examination were:

Perivascular infiltrate which consisted chiefly of lymphocytes and a few plasma cells. There were many vessels involved in this manner, regardless of size, and both the veins and arteries were affected. Case 2 differed in that the vessels which showed changes in their walls were not so often seen to have this perivascular infiltrate.

Pan-arteritis and pan-phlebitis, described by Fraenkel and considered by him to be highly characteristic of this condition, if associated with such other changes as an infiltrate,

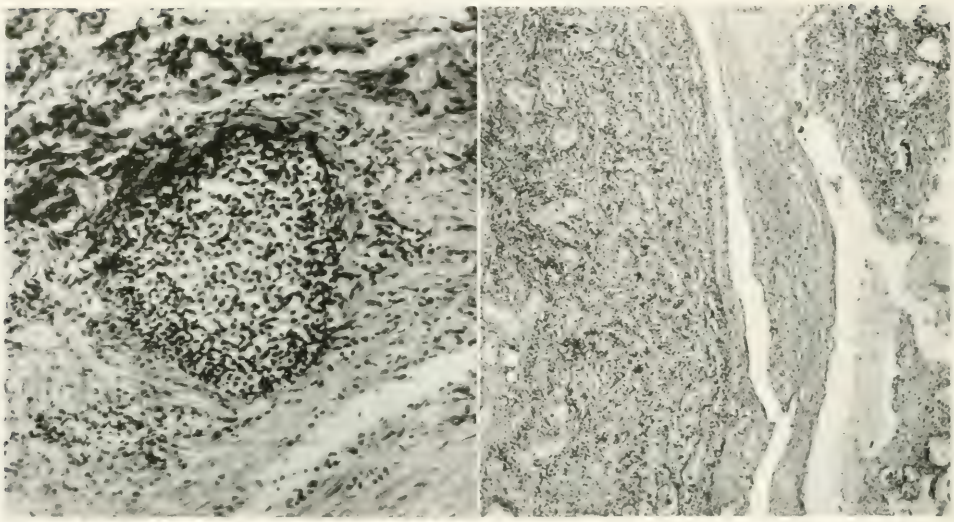


Fig. 5 (at left). Miliary gumma in muscular layer consisting of lymphocytes and a few plasma cells on a framework of delicate connective tissue and containing a few capillaries. Some epithelioid cells near periphery. No necrosis or caseation.

Fig. 6. Ulcer base showing diffuse infiltrate of lymphocytes and coat of fibrin enclosing some leucocytes and débris.

etc., were present. The process evidently began in the outer layers of the vessels and then attacked the media and intima. The earliest changes were a teasing apart of the elastic fibers of the adventitia with infiltration by round cells. The media was next affected and then the intima but this layer did not show the tearing apart of the elastic fibers to the same degree as did the adventitia. Fibrosis then occurred and the vessel became permanently changed. The lumen became narrowed and in many instances completely obliterated during the stages of infiltration and fibrosis. It is interesting to note that the vascular involvement was in patches and did not affect the entire circumference. The changes in the veins were probably the cause of the marked œdema of the submucosa, but it is curious that there was no necrosis in the presence of the extensive arterial changes. The pan-arteritis was not so marked in Case 2, and only a moderate degree of endarteritis was present in this case, but not any more than in ordinary peptic ulcer or in the vicinity of any other chronic inflammation.

Both specimens contained miliary gummata, the number in Case 2 being much greater than in Case 1. These were located chiefly in the submucosa but some were present in the muscular layers as well. This change consisted of a circumscribed collection of cells, chiefly lymphocytes but also a few plasma cells at the periphery. Both elements rested on a fine connective-tissue framework and an occasional capillary was seen within the gumma. The whole was surrounded by a thin connective-tissue capsule but there was no marked vascular reaction in the vicinity nor were there large vessels near by. This was quite distinct from the other forms of infiltrate, and no necrosis or caseation was present. A few epithelioid cells were present near the periphery, and Case 2 showed one with a giant cell of the Langhans type.

The diffuse infiltrate consisted chiefly of lymphocytes and a few plasma cells with an occasional giant cell. A few polynuclears were present near the surface. The infiltrate was very extensive and was found chiefly at the base of the ulcer. There were many capillaries and a number of extensive hæmorrhages, especially near the mucosa. This collection of free blood was seen at one place to lift off the overlying mucosa. This may have been one of the factors in the formation of the ulcer.

Other and less important changes were a round-cell infiltration of the interstitial tissue of the mucosa with occasional hæmorrhage. A coat of fibrin containing some leucocytes and d'bris covered the base of the ulcer. The muscular layers showed evidences of fibrosis and slight round-cell infiltration, and the peritoneum was practically normal. Both specimens showed an occasional round-cell infiltration around the nerves in the muscular layer. This may, perhaps, be one of the causes for the pain.

A careful search was made for spirochætæ but none was found. This does not speak against the diagnosis, as it is well known that the causative organisms are seldom found in tertiary lesions. McNee (71) described changes very similar to those in these specimens and in which he demonstrated spirochætæ in the submucosa very closely resembling the treponema pallida.

There were a few long, Gram positive bacilli and Gram positive cocci at the surface of the ulcer but no tuberculosis bacilli were found.

A study of 135 additional cases selected from the literature was then undertaken with a view of establishing a clinical picture. This series included the 14 cases proved anatomically and those in which the diagnosis, when based on clinical findings alone, seemed fairly certain.

According to Bensaude (72), there are four types: ulcerative, tumefactive, linitis type, and stenosing type. The nature of the underlying pathology will determine the type and the resulting symptoms, but there are clinical manifestations which are common to all forms and which will be briefly described.

Pain in the epigastrium with occasional radiation was present in all but three instances (29, 73, 74) and was the most frequent and important symptom. It was usually severe and became worse after meals, but all varieties and degrees were noted. The pain was at first relieved by alkalies but subsequently only vomiting gave relief. The most frequent type was boring or burning and it was constant in many instances.

Anacidity and marked *subacidity* were found in 80 of the 93 instances in which the stomach contents were examined and reported. This was present in both of our cases.

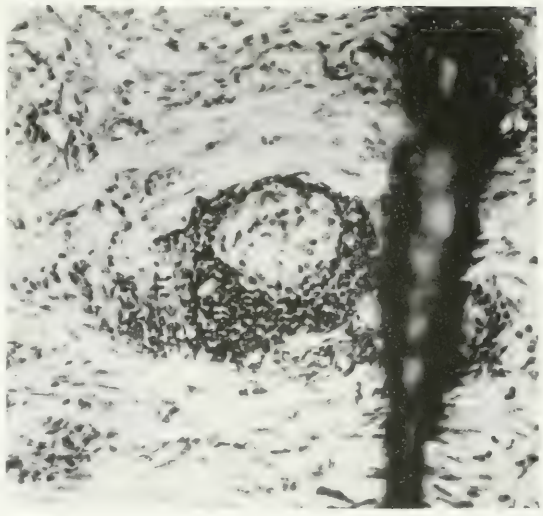


Fig. 7. Perineural infiltrate of round cells in muscular layer.

Emaciation was usually marked, the average loss being from 30 to 40 pounds, and one author reported a loss of 75 pounds. This sign was present in 88 per cent of the cases. A marked anæmia often accompanied the emaciation and often gave rise to the impression that there was cachexia.

It is difficult to determine the actual rate in which there was *evidence of luetic infection*, as many of the cases were reported in the days before the Wassermann came into use. The Wassermann test was reported in 89 cases and was positive in 96 per cent, the great majority being 4+. There were 9 additional cases in which no Wassermann was reported but in whom positive evidence of syphilis was found. Two instances are reported in which the Wassermann was negative in spite of the fact that the condition was syphilis, as proved by other clinical evidence and the results of specific treatment (75, 76).

Reaction to *specific treatment* is especially characteristic if previous management has failed. There were 125 reports in this regard and the results were: clinical cure in 60 per cent, improvement in 33 per cent, and failure in 7 per cent. There were some cases in which the contour of the stomach, as seen on X-ray

examination, returned to normal and a few instances in which a previously anacid gastric juice returned to normal after specific treatment.

The findings on X-ray examination varied to a great extent and were usually very much like those found in carcinoma. Signs of obstruction and filling defects were the chief features, but it is difficult to point out changes which are pathognomonic of syphilis.

The other and less characteristic symptoms were hæmatemesis, constipation, vomiting, tenderness in the epigastrium, large liver and blood in the stools. These were not found in a sufficiently large number of instances to warrant particular attention as characteristic of gastric syphilis.

RÉSUMÉ

The clinical evidence of gastric syphilis consists of pain in the epigastrium, low acidity, marked emaciation, history or evidence of luetic infection, and a good result with specific treatment. To this should be added that the patient is often under the usual age for carcinoma and that the course is often over a period of years.

The anatomical features are multiple, irregular ulcers; thick submucosa; vascular changes; miliary gummata; perivascular infiltrate; and diffuse infiltrate, in which the predominating element is the lymphocyte.

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SYPHILIS OF THE STOMACH[1]

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SYPHILIS of the stomach shares with syphilis of other viscera the difficulty of final differential diagnosis. Active syphilis, as evidenced by clinical manifestations other than gastric or by a positive Wassermann reaction, is suggestive of that etiology of a coincident gastric syndrome.

The literature recently has contained exhaustive summaries of the reports of gastric syphilis. Those of Eusterman (1), Fowler (2), and Morgan (3), review adequately the previous literature. Eusterman states: "The symptomatology which is fairly characteristic of gastric syphilis is suggestive of benign gastric ulcer, and the gastric chemistry and roentgenological findings suggest carcinoma." He says also that if both the anamnesis and the Wassermann are negative, the possibility of gastric syphilis is not excluded. Morgan states: "A diseased condition of the stomach marked by a long duration with changeable symptoms which do not correspond to one or the other of the well-recognized diseases of that organ, and which resist the accepted methods of treatment, should arouse suspicion" (of syphilis).

Gastric syphilis has no characteristic clinical picture. The facility with which syphilis imitates disease of other etiology is very evident in gastric syphilis. Different types and stages of gastric syphilis present markedly different pictures. A clinical course, unusual to that of the suggested disease, gives the clue. With all possible data the diagnosis is made in large part by exclusion.

Case 1. P. C., white, age 32, married. Patient has been ill 4 months. Onset was sudden, following a large meal. The pain begins 30 minutes after a meal and increases in intensity until vomiting results in about 2 hours. Vomiting gives relief. Patient has lost in weight and strength. Physical examination revealed nothing of note except the loss of weight and a point of tenderness in mid-right epigastrium. There was no palpable mass. Laboratory tests showed a positive blood Wassermann; achlorhydria.

[1] From X-Ray Department, Medical School, Washington University

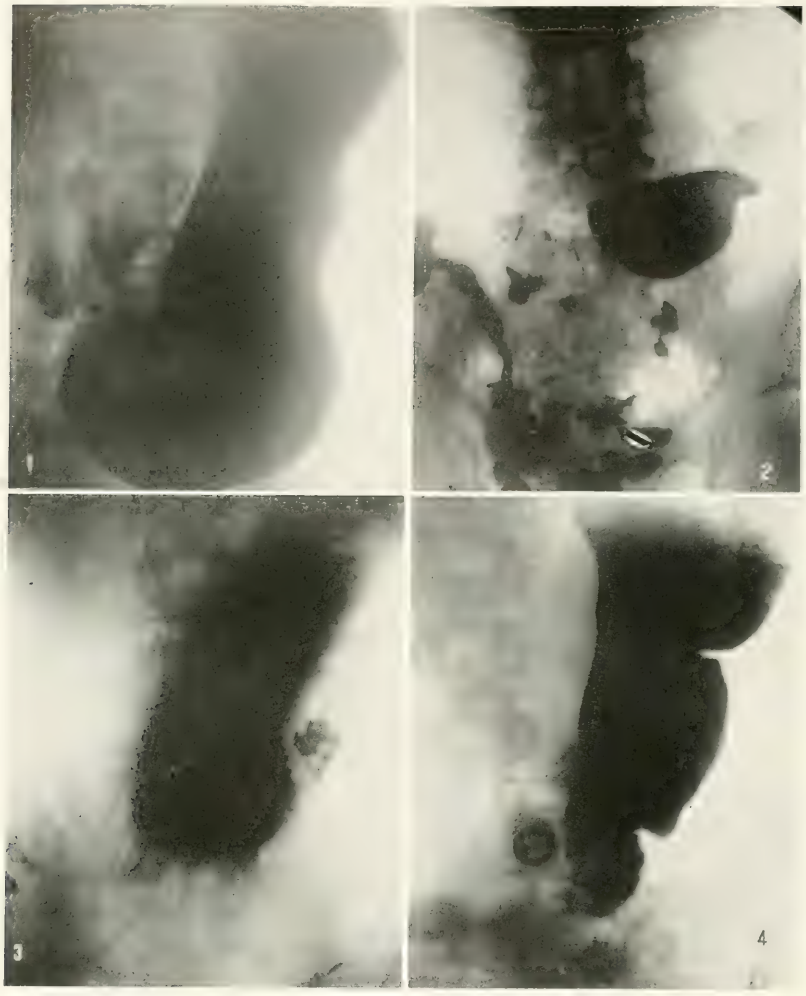


Fig. 1. The filled stomach shows the prepyloric lesion. (Case 1.)

Fig. 2. The stomach at 6 hours shows much residue. There was marked motor impairment. (Case 1.)

Fig. 3. The stomach (prone position) at 24 hours, shows much residue. This results from the great motor impairment. (Case 1.)

Fig. 4. The stomach, postoperative, shows adequate functioning of the gastrojejunostomy. (Case 1.)

No occult blood was found in the stools. X-ray examination showed marked gastric motor insufficiency due to a prepyloric lesion which was highly suggestive of syphilis.

At operation a gastric resection and gastrojejunostomy was done by Dr. Ellis Fischell, who considered the condition luetic. Antiluetic treatment was begun. The clinical result was perfect.

The microscopic report (Dr. M. T. Burrows) was: chronic inflammation. Gumma. (Figs. 1, 2, 3, 4.)

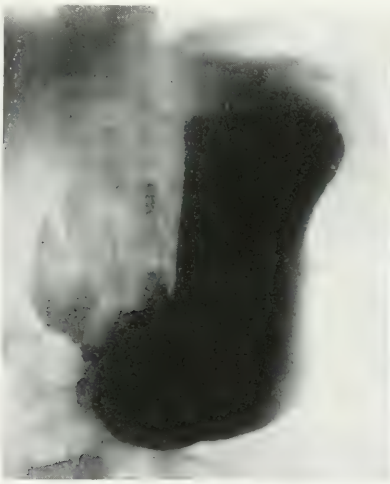
Case 2. E. B., colored, age 39, married. The illness was intermittent and variable during 5 years. Vomiting occurred immediately after eating and infrequently the vomitus showed food residue from the previous day. There was loss of weight from 137 to 101 pounds in the previous 4 months. Physical examination showed nothing important except loss of weight. Laboratory tests showed positive blood Wassermann; marked gastric hypoacidity; and the stool contained no occult blood.

After a 7 months' disappearance and without antiluetic treatment she gave a similar clinical picture, but with more frequent vomiting and this more often with residual food. X-ray examination now showed a lesion involving the prepyloric stom-

Fig. 5. The stomach, partially filled, shows a prepyloric lesion. It was not palpable. (Case 2.)

Fig. 6. Hyperperistalsis is shown. (Case 2.)

Fig. 7. The stomach, postoperative, shows adequate functioning of the gastrojejunostomy. (Case 2.)



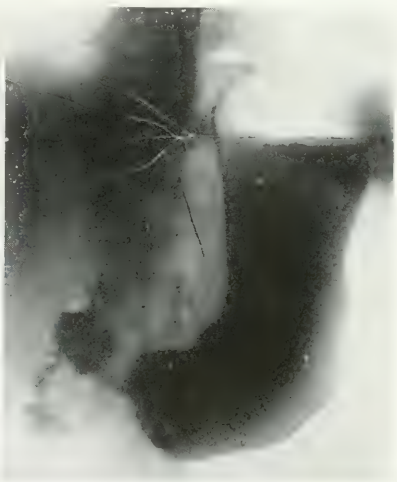


Fig. 8 (at left). The stomach shows the prepyloric lesion. It was not palpable.
Fig. 9. The stomach 3 months after observation in Figure 8. (Case 3.)

ach with resulting organic motor insufficiency. The lesion was considered luetic. It was not palpable.

A gastric resection and gastrojejunostomy was done by Dr. E. A. Graham. A small tumor the size of a hazel nut and having a flat base was found to obstruct the pylorus.

The microscopical diagnosis was chronic inflammatory disease. No carcinoma could be found. X-ray examination showed admirable postoperative conditions of the remaining stomach and stoma, and the clinical result was excellent.

Case 3. E. P. G., white, female, age 31, married. The duration of the illness was 8 years. Vomiting occurred seldom, perhaps once a month, and then immediately after meals, and was not associated with pain. More frequent attacks had occurred during previous 2 years, and each had continued 10 to 14 days and with persistent vomiting. There was severe gastric hæmorrhage twice. Loss of 80 pounds in weight had occurred in the year previous.

Physical examination showed nothing of note except for the evidence of loss of weight. Laboratory tests showed positive blood Wassermann; gastric hypochlorhydria. The vomitus gave a positive occult blood test, the stool gave a positive occult blood test. X-ray examination showed gastric motor insufficiency due to a high-grade annular filling defect involving distal pyloric stomach, characteristic

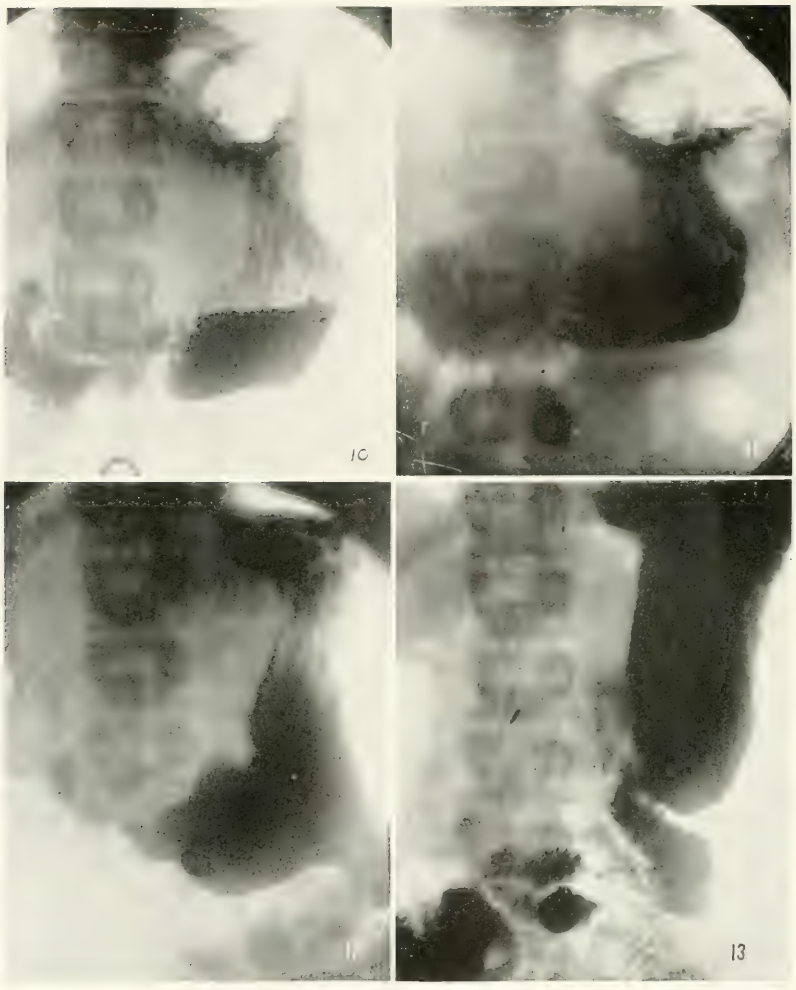


Fig. 10. The stomach shows a prepyloric deformity. There was no palpable mass. (Case 4.)

Fig. 11. Fourteen months after observation shown in Figure 10. (Case 4.)

Fig. 12. The stomach, postoperative, shows adequate functioning of the gastro-enterostomy. The prepyloric deformity persists. The case was not benefited clinically. (Case 4.)

Fig. 13. The stomach (after second operation) shows condition after prepyloric resection. The gastro-enterostomy was not altered. The patient was greatly improved. (Case 4.)

of carcinoma, however, without palpable mass or tenderness. The lesion was possibly luetic. Second X-ray examination 3 months later was essentially the same.

At operation (Dr. E. A. Graham) the stomach wall was found thickened. There was no pyloric stenosis. Appendectomy was done. Pieces of stomach were excised for histological examination. Microscopical examination of the mucosa and the stomach wall showed chronic inflammatory disease and chronic atrophic gastritis. The mucosa was thinner than normal. The outer border was infiltrated with small and medium sized mononuclear cells and typical polyblasts and plasma cells and scattered polymorphonuclears.

This patient improved somewhat under antiluetic treatment. Observation of the condition was terminated by death of the patient following an abortion.

Case 4. W. R., male, colored, age 22, married. The illness was of 5 years' duration, with periods of acute exacerbation. Vomiting occurred frequently

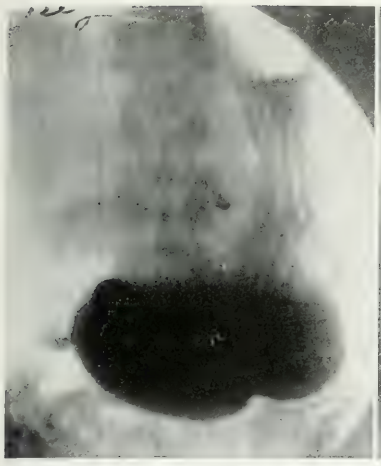


Fig. 14. Ulcer crater shows on lesser curvature. (Case 5.)

Fig. 15. The stomach at 6 hours shows much residue. There was a high-grade motor impairment.

Fig. 16. The stomach, postoperative. shows an adequately functioning gastro-enterostomy. (Case 5.)

and relieved pain. He had noted food of day previous in the vomitus. The pain was located in the left upper quadrant and occurred immediately after drinking or eating, and especially during the night. It was relieved by vomiting. Venereal disease was denied. Physical examination showed nothing of note. There was no palpable abdominal mass. Laboratory tests showed negative blood Wassermann on three occasions, negative spinal fluid Wassermann; slight gastric hypochlorhydria. The stool contained no occult blood. X-ray examination showed a superficial lesion involving the prepyloric stomach and of a type suggesting luetic ulceration.

The case was observed on dietetic and antiluetic treatment for 8 months without notable change. He could not at any time care for a full and rough diet. Vomiting with residual food invariably resulted. The barium X-ray meal showed good total motility. X-ray re-examinations gave the same findings as originally.

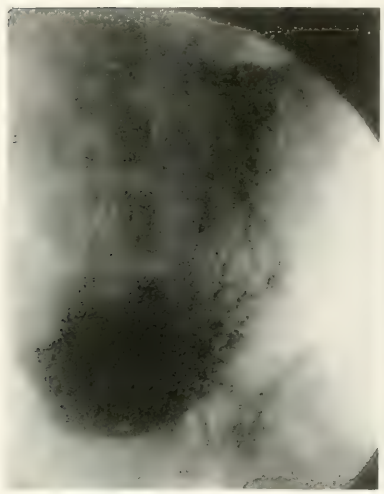
A gastric enterostomy was done by Dr. E. A. Graham. Only thickening of prepyloric region was noted. A pathological appendix was removed.

X-ray examination, 16 days postoperative, showed a freely functioning gastro-enterostomy stoma, and there was no evidence of repair of the lesion of the pars pylorica. The subsequent course was little different than prior to operation and after approximately 1 year a second operation was done by Dr. Graham with resection of the stomach distal to the gastro-enterostomy. The resected stomach showed increased thickness and firmness. Microscopical sections showed an increase of fibrous tissue in all layers. The subsequent clinical course has been good since the gastric resection.

Case 5. M. A. H., white, male, age 39, single. The duration of illness was 5 years. Vomiting occurred after meals. Antiluetic treatment and appendectomy had improved the symptoms. The recent acute illness was characterized by abdominal cramps, nausea, and vomiting soon after meals. The vomitus was of large amount; old food was not noted. There was a loss of 23 pounds in weight in 10 weeks. Physical examination showed advanced central nervous system syphilis. The abdomen showed an appendectomy scar, rigidity and tenderness in epigastrium, and a palpable flat mass in the left epigastrium size of pigeon's egg. It had no definite respiratory excursion. Gastric lavage gave 1000 cubic centimeters of residual fluid. The occult blood reaction was strongly positive. X-ray examination showed organic gastric motor insufficiency due to a penetrating ulcer of lesser curvature.

At operation Dr. E. A. Graham did a posterior gastro-enterostomy. The lesion was found firmly adherent to contiguous structures and was considered non-malignant. The omentum showed numerous small tubercles. A piece of stomach wall showed microscopically chronic inflammatory change. The postoperative X-ray examination showed prompt gastric motility. Gastro-enterostomy stoma functioned admirably. The gastric ulcer "crater" persisted, although it had decreased in size and was more shallow than at the initial examination.

This case had received treatment for central nervous system syphilis and not until a palpable mass appeared had the possibility of an organic gastric pathology been considered. Tabetic crises had explained the pain. The rarity of true gastric crises without any organic pathology in the stomach is becoming more and more evident with the more frequent use and the greater accuracy of the direct



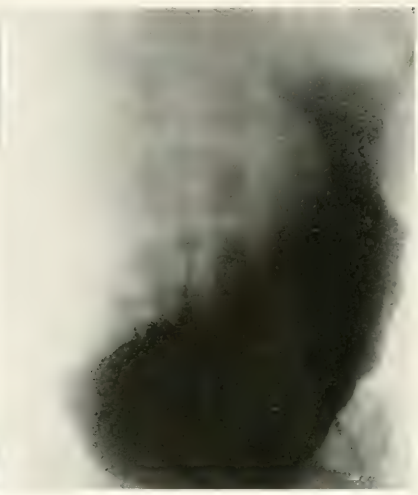


Fig. 17 (at left). The stomach shows hypertrophic rugæ and distortion of the prepyloric portion. (Case 6.)

Fig. 18. The stomach shows distortion of prepyloric portion. There was no palpable mass. Motility was normal. (Case 6

diagnostic approach of roentgenology. Mills (4) states that he has never failed to find evidence of an organic lesion in all cases of so-called gastric crises in eight thousand or more gastro-intestinal X-ray examinations.

Case 6. O. H., white, age 28, married. The duration of the illness was 4 months, and had become progressively worse. There was a burning sensation in the left epigastrium associated with nausea, but without vomiting. There was a loss of 14 pounds in weight. Physical examination disclosed only slight

TABLE I.—SUMMARY OF CASES

Case No.	Age	Duration	Weight Status	Pain	Vomiting	Wasser mann	Gastric H Cl.	Occult Blood, Stool	Palpable Abdominal Mass	X-Ray Findings	Type of Operation	Antiluetic Treatment	Microscopic Pathology	Clinical Result
1	32	More than 4 mos.	Loss	Soon p. c.	2 hrs. p. c. relief	Pos.	o	o	o	Prepyloric lesion, luetic, stenosis	Resection		C. I. Gumma	Good
2	39	5 yrs.	Loss 36 lbs. 4 mos.	None ?	Immed. p. c. relief	Pos.	H.	o	o	Prepyloric lesion, luetic, stenosis	Resection		C. I.	Good
3	31	8 yrs.	Loss 80 lbs. in 2 yrs.	None	Immed. p. c.	Pos.	H.	Pos.	o	Prepyloric lesion, luetic, stenosis	Resection		C. I. Gumma	Good
4	22	3 yrs.	Loss	Immed. p. c.	Soon p. c. relief, residue noted	Neg.	H.	o	o	Prepyloric contractive lesion, good motility	Gastro-enterostomy			Poor
											Later Resection			Good
5	40	3 yrs.	Loss 23 lbs. in 3 mos.		Soon p. c.	Pos.		o	Pos.	Impaired gastric motility ulcer	Gastro-enterostomy			Good
6	28	4 mos.	Loss 14 lbs.	None	Soon p. c. relief	Pos.	H.		o	Good gastric motility		Plus		Good
7	39	3 yrs.	Loss in 4 mos.	Immed. p. c.	Soon p. c. relief	Pos.	H.	o	o	Good gastric motility		Plus		Good
8	39	9 yrs.	Loss 12 lbs. in 1 yr.	Immed. p. c	Soon p. c. relief	Pos.			o	Prepyloric lesion, stenosis, luetic				

H = Hyperchlorhydria. o = None. Blank = No observation. p. c. = After meals. C. I. = Chronic inflammation

Fig. 19. The stomach shows hypertrophic rugæ. (Case 7.)

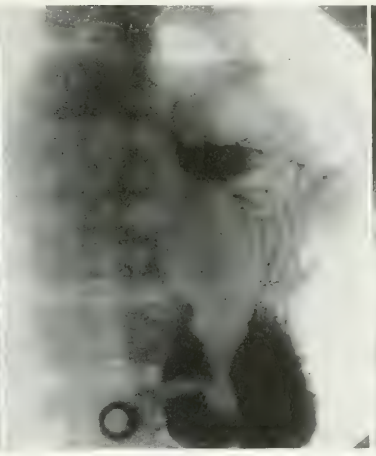


Fig. 20. The stomach shows hypertrophic rugæ. This observation was 13 months after that of Figure 19.

Fig. 21. The stomach shows hypertrophic rugæ. This observation was 14 months after that of Figure 20.

tenderness in left hypochondrium. Laboratory tests showed positive blood Wassermann on two occasions; and gastric hypochlorhydria. X-ray examination of the stomach showed hypertrophic rugæ suggestive of an inflammatory reaction. There was no improvement on an ulcer treatment of diet and alkaline medication. There was prompt relief of symptoms and gain in body weight on antiluetic treatment.

Case 7. M. V., colored, age 49, married. The illness was of 4 months' duration. The chief symptoms were precordial pain and an inability to eat rough foods without epigastric pain and vomiting. He had had similar trouble previously, but never so severely or persistently. Physical examination showed evidence of marked loss of weight, signs of central nervous system syphilis, and signs of aneurysm of the aortic arcus. The abdomen showed a slight tenderness in the right upper epigastrium. Laboratory tests showed positive blood Wassermann and moderate gastric hyperchlorhydria. There was no occult blood in the stool. X-ray examination showed an atypical contour and rugæ of distal stomach. There was an aneurysm of the arch of the aorta.

Mercurial treatment relieved all gastric symptoms, and the patient could take a full general diet. There was a prompt gain in weight.

Case 8. M. B., colored, age 39, married. The illness was of 9 years' duration. The chief symptoms were epigastric pain, which was worse immediately after eating. It caused vomiting, which gave prompt relief. There was a loss of 12 pounds in weight during the year. Physical examination gave a moderate tenderness in the right hypochondrium and in the right lower quadrant. There was no palpable abdominal mass. Laboratory tests showed positive blood Wassermann. X-ray examination showed a prepyloric lesion resulting in pyloric stenosis of high grade. The lesion was not palpable.

These cases fall into a group definitely separated from other gastric disease. The final proof of their luetic etiology, namely, the demonstration of the spirochæta pallida, is lacking. In some the picture of gumma and of perivascular changes are highly presumptive of the histopathology of syphilis.

Five cases may be grouped as all showing gastric motor impairment. In these the duration of illness had been from 1 to 9 years. Loss of weight had occurred over a period of from 3 months to 1 year. Duration of loss of weight probably coincides with duration of gastric motor impairment. In all, vomiting occurred immediately or soon after eating. Hydrochloric acid was lacking or markedly reduced in all. The vomitus in two cases had shown food stasis in the stomach. Pain was variable and not characteristic. Only one case showed occult blood in the stool, and only one case failed to show a positive Wassermann. Four of these cases (1, 2, 3, and 8) had clinical and X-ray evidence of pyloric obstruction. One other (Case 4) had clinical, but not X-ray, evidence of the same. None had a palpable abdominal mass. The X-ray picture in each case was that of a prepyloric lesion, which was not characteristic of carcinoma or of prepyloric ulcer.

Most pyloric obstructions are the result of cancer, prepyloric ulcer, or of duodenal ulcer. Yet the age incidence, the duration of the ill-

Fig. 22. The stomach shows prepyloric lesion. It was not palpable. (Case 8.)

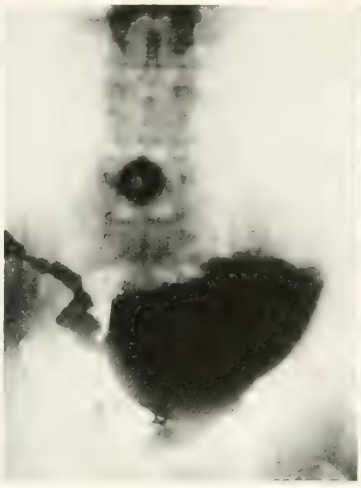


Fig. 23. The stomach, at 6 hours, shows large residue. There was marked gastric motor impairment.

Fig. 24. The stomach, at 24 hours, shows large residue. There was great motor impairment.

ness, the failing nutrition without cachexia, the occasion of vomiting early in the digestive cycle, and the absence of palpable abdominal findings and of occult blood in the stool, each questions, and all together cast great doubt upon a diagnosis of cancer Prepyloric ulcer is poorly supported by the ensemble of the clinical findings. The X-ray picture is not that of the usual prepyloric ulcer.

Four cases were operated upon. Three received gastric resections and yielded excellent clinical results. The fourth had a resection at a secondary operation and gave a good clinical result. This case was the only one of this group which showed good gastric motility by X-ray examination, although showing clinically a food stasis. Graham (5), in writing on the surgery of syphilis of the stomach, has summarized all reported cases operated upon for gastric syphilis, and shown that the clinical result is uniformly remarkably better after resection than after simple gastro-enterostomy.

The microscopical pathological report in two cases was gumma, and in the two others was chronic inflammatory disease.

Cases 6 and 7 gave histories and findings very similar. One only showed vomiting and pain. Neither gave clinical or X-ray evidence of impaired gastric motility. Both has positive Wassermann reactions. Their clinical response to antiluetic treatment was excellent.

CONCLUSIONS

Consideration of these cases in connection with the previous literature emphasizes the following points:

1. Gastric syphilis manifests a variable symptomatology, a chemistry, and X-ray findings that cannot consistently be of other well-recognized gastric disease.

2. The presence elsewhere of other undoubted signs of syphilis is a very large support to the diagnosis of syphilis of the stomach, and when absent great care must be used in making that diagnosis.

3. Successful medical treatment is diagnostic only in early gastric syphilis. Restoration to normal gastric motility cannot be expected in well-advanced gastric syphilis. The clinical response to antiluetic treatment will not then be helpfully diagnostic.

4. Surgery is indicated in late cases with permanent impairment of the gastric motor function. It is indicated by the clinical course and by the X-ray findings. Resection of the prepyloric stomach is the preferred operation.

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LUETIC OBSTRUCTION OF THE ŒSOPHAGUS

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TERTIARY syphilitic lesions of the œsophagus are very rare. This disease was first described in the middle of the eighteenth century. Wile (1) reviewed the literature and reported a case on this subject in a very excellent paper in 1914. According to him, up to 1906, only thirty authentic cases had been collected in all the literature, by Gaston. Since Wile's publication no reports can be found in the *Index Medicus*, the *Quarterly Cumulative Index of the American Medical Association*, and the *Index Catalogue* of the Surgeon General's Office except one case by an Italian author in 1915.

Tertiary syphilitic lesions of the other thoracic organs, however, are not so infrequent. The occurrence of aortic aneurism, gumma of the heart, lesions of the respiratory organs, the mediastinal lymph glands, and of the sternum are examples. Involvement of the mucous membranes of other parts of the gastro-intestinal tract in luetic infections is more common. The mouth, the tongue, and the rectum have been recognized for a long time as sites for tertiary manifestations of syphilitic disease. More recently tertiary lesions of the stomach have been investigated and found to be not as infrequent as was formerly supposed. Many cases had been confused with gastric cancer, and it is likewise possible that some of the cases of œsophageal obstruction might have been of luetic origin.

The local pathology of the lesion is similar to the disease elsewhere, producing one or more gummata of the submucosa with ulceration and resulting contraction and narrowing of the lumen. The process may be localized or diffused, single or multiple, of varying degree. There is dilatation of the œsophagus above the site of obstruction. The mediastinal lymph glands may be involved and enlarged appreciably. Three cases, including Wile's, were of the diffuse type. Syphilitic œsophagitis that occurs as a secondary manifestation of the disease is excluded from this discussion.

The clinical symptoms of luetic stricture of the œsophagus are those associated with obstruction in the swallowing act, superimposed upon the systemic infection. Dysphagia is usually the first to be complained of, and is gradual and progressive. Loss of weight follows, due in part to dietetic restrictions and possibly to the effects of the systemic infection. Cachexia and loss of strength are not as pronounced as the weight loss, a condition also noted in organic gastric syphilis. Emesis may be present, depending on the degree of obstruction. Pain is usually absent. The history of an infection may be denied. Men are more often affected than women. The age incidence and the interval between the primary infection and the onset of the obstructive lesion are not known.

The objective findings are the evidences of loss of weight and possibly suspicious lesions elsewhere that suggest lues.

The laboratory findings are of great aid in the diagnosis. Careful serological tests should be made in all cases of œsophageal obstruction and appraised accordingly. All cases of dysphagia should have a careful X-ray examination of the œsophagus and at times the stomach as well. Both fluoroscopic and roentgenographic methods should be used, employing a thick bismuth mixture that will not pass too easily and too rapidly. The opaque medium will readily indicate the presence and the degree of an obstructive lesion at an early date.

The differential diagnosis of luetic stricture must be made from a large number of œsophageal lesions accompanied by dysphagia, from a correlation of the history, the physical examination, the serological tests, and the roentgen examination. Traumatic stricture, foreign body, diverticulum, and cardiospasm are readily differentiated by the X-ray. Carcinoma of the œsophagus presents the clinical picture of a more pronounced cachexia, is of more rapid progress, is usually located in the middle third or at the cardia. The X-ray

Fig. 1. Stricture of the œsophagus with dilatation proximal to the site of the obstruction.

findings of obstruction with dilatation above the site of the lesion are common to both types of disease (Fig. 1). In carcinoma though, the filling defect may be more abrupt, irregular, and moth-eaten, and the canalization may be more eccentric and tortuous. A history of luetic infection, the presence of other tertiary lesions, and the Wassermann test will aid in the differential diagnosis. Then, too, the therapeutic test of appreciable improvement under thorough specific treatment will usually confirm the diagnosis. Finally, the X-ray filling defect and the obstruction are not appreciably effaced by instrumental dilatations in cancer. Pedunculated polypi, angioma, and other benign neoplasms must be thought of and excluded by œsophagoscopy in doubtful cases. The other infectious granulomata can be excluded by a careful history, negative Wassermann tests, and absence of evidences of these infections elsewhere. Extensive intrathoracic pressure on the œsophagus is usually not associated with a similar degree of dysphagia and obstruction, if dysphagia is present at all. Many cases with a large mediastinal tumors have been recorded which have shown no difficulty in swallowing. In this latter group of cases the pressure symptoms are referable more to the respiratory and to the circulatory systems. Physical examination and X-ray examination will show the presence of a marked increase in the mediastinal dullness and density. Dysphagia has been noted in certain cases of Pott's disease with abscess formation, and also in certain diseases of the central nervous system, but here the exciting or underlying causes can easily be detected. Segmental muscle spasm (exclusive of cardiospasm) may possibly occur from abrasions or simple ulcerations, or nervousness, but cannot be demonstrated if they ever do occur as a cause of dysphagia. Such spasm has been seen as a reflex of an early carcinoma (2).

The treatment of syphilitic stricture of the œsophagus is two-fold. A well-balanced diet to maintain nutrition and thorough and competent antiluetic therapy is imperative, preferably by a specialist. Instrumental dilatation with a set of graduated metal dilators passed on a string guide with a flexible staff should be carried out frequently and regularly as needed to enlarge the lumen and keep it dilated. This can be done without an anæsthetic, caution being used to dilate gradually and slowly and without too much force on account of the possible danger of traumatic perforation or hæmorrhage. The progress in the treatment of obstruction can be followed in fluoroscopic examinations. Gastrostomy should be done in obstinate cases not yielding to the more conservative treatment.

The prognosis will depend upon many factors but should be good if the infection can be controlled and the obstruction relieved. It is reported to be bad in the presence of extensive fibrosis of long standing.

A white, obese, male patient, age 63, was referred for examination on June 1, 1922, with a diagnosis of obstruction of the œsophagus. Previous history was entirely negative except that he had been married 21 years without his wife being pregnant, and that venereal infection had been denied at first but later admitted as having had a painless extragenital chancre 26 years ago of 6 weeks' duration, and had been treated medically for 18 months thereafter. His chief complaints were progressive dysphagia and loss of weight since October, 1921. He had a sticking sensation in swallowing in mid-œsophagus but no pain. In April and May, 1922, he had ten dilatations elsewhere for obstruction supposed to be malignant. He has been dieting more or less since the onset.

Physical examination showed a man weighing 208 pounds, with evidences of weight loss, with liver uniformly enlarged measuring 6 centimeters below costal margin in the right mammary line, with spleen palpable on deep inspiration. Balance negative.

The laboratory findings were as follows: urinalysis, negative; blood Wassermann tests, four plus and three plus respectively; negative X-ray of œsophagus and stomach for obstruction. (Patient had been dilated.)

Summary and conclusions: visceral lues; dysphagia; no evidence of malignancy. Refer for antiluetic treatment. Re-ray œsophagus in 6 to 12 weeks if necessary.

Follow-up record: The patient was given thorough specific treatment elsewhere with improvement after salvarsan and potassium iodide, but more recently on mercury injections over a period of time his dysphagia recurred, and with it a loss of weight. Examination on November 20, 1922, showed his weight to be only 191 pounds and some muscular weakness. X-ray examination revealed a moderate obstruction in the middle third of the œsophagus slightly above the level of the nipples, with 50 per cent reduction in the diameter of its lumen. The stricture was smooth and concentric. Marked dilatation above the site of stricture.

Diagnosis: stricture of œsophagus, middle third, luetic.

Treatment. November 24, 1922, dilatation of stricture of œsophagus with Nos. 35, 37, 39, 41, 43 and 45 (F) metal dilators; no bleeding; stricture localized and yields with some difficulty, especially with the last two dilators; no anæsthesia.

December 4, 1922, dilated with Nos. 35, 37 and 39 (F).

December 5, 1922, dilated with Nos. 39, 41 and 43.

December 6, 1922, dilated with Nos. 43 and 45.

December 9, 1922, re-rayed and showed slight retardation at site of old stricture—lumen smooth and greatly enlarged. Dilated with Nos. 41, 43 and 45, without difficulty.

December 16, 1922, dilated with Nos. 43 and 45, no obstruction.

December 30, 1922, dilated with No. 45, no obstruction, no dysphagia.

January 14, 1923, dilated with Nos. 43 and 45, no obstruction, eats freely of all foods, no dysphagia.

January 28, 1923, dilated with No. 45, no obstruction, no dysphagia.

February 10, 1923, dilated with No. 45, no obstruction, no dysphagia. Further dilatations are to be given as needed, and in addition he is receiving careful specific therapy.

SUMMARY

1. Stricture of the œsophagus is a rare complication of visceral syphilis.

2. It may simulate carcinoma of the œsophagus or other obstructive lesions.

3. The clinical history,—positive serological tests, X-ray findings, and signs and evidences of syphilis elsewhere—will aid in the differential diagnosis.

4. Thorough antisyphilitic treatment is imperative.

5. The obstructive features of the disease are surgical and respond to instrumental dilatations. These dilatations must be repeated at varying intervals over a long period of time.

6. Gastrostomy should be performed in obstinate or advanced cases, if necessary, to maintain nutrition, if the more conservative methods fail promptly to relieve the obstruction.

7. The possibility of a malignancy being superimposed upon a syphilitic ulceration must be considered.

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GASTRO-ENTEROSTOMY[1]

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THOSE of us who graduated in the early eighties will remember that Nicolandini first suggested gastro-enterostomy for pyloric obstruction, and his suggestion was acted upon by Woelfer, September 28, 1881, when operating upon a patient with a cancer of the pylorus too large to be excised, he performed a gastro-enterostomy by the anterior method; the patient's condition was improved by the operation. The anterior operation, however, fell into disrepute because in it the jejunum is drawn over the transverse colon and may possibly constrict it and lead to obstruction, and also because with the long loop there is apt to be a drag on the gut producing a spur or kink resulting in the establishment of a vicious circle.

When radical operation (sub-total gastrectomy) is out of the question anterior gastro-enterostomy is now very seldom done; in fact, the only reason for attempting it is when, because of existing pathology, the posterior method is impossible.

The chief objection to anterior gastro-enterostomy as usually performed is the presence of a long loop of jejunum. It not infrequently happens that the proximal half of the long loop, owing to its inability to drive its contents onward, becomes water-logged, resulting in the vomiting of bile, a variety of vicious circle, or in one or another type of postoperative vomiting, such as:

1. Regurgitation of duodenal contents through the pylorus;
2. Escape of fluid from the stomach into the afferent loop;
3. Escape of fluid from the afferent loop into the stomach; and
4. Regurgitation of the contents of the efferent loop into the stomach.

The third of these conditions is believed to be the most common as well as the most serious. I have always thought it best when making an anterior gastro-enterostomy also to make an entero-enterostomy (jejuno-jejunostomy) at the most dependent point of the afferent or proximal loop.

It was left to von Hacker to suggest the anastomosis by the posterior method.

Gastro-enterostomy for ulcer was first performed by Doyen in 1893, after both he and Talma had independently come to the same conclusion, namely, that spasm of the pylorus was the chief factor in maintaining hyperchlorhydria and that this prevented the healing of a gastric ulcer. It will probably be remembered that Rydygier performed the first operation for the cure of gastric ulcer in 1881, when he resected a large ulcer on the posterior wall of the stomach. Since those early days the names of Paterson, Mayo Robson, Moynihan, Key, the Mayos, Finney, and more recently Judd, Balfour, Wilensky, and others too numerous to mention, have been associated with the development of surgery in relation to ulcer of the stomach and duodenum.

We must not forget the work of Beaumont, of Pavlow, of Bayliss and Starling, of Cannon and of Carlson, in regard to gastric digestion; nor that of Gaskill, Langdone Brown and Alvarez on the nervous control of the stomach and duodenum. Too often in the past, before these contributions to the subject, gastric surgery had been worse than a failure, not so much with regard to the anatomy as with reference to the actual pathology and physiology of the digestive organs.

An interesting point brought out by Carlson, in his most recent work on the physiology of the alimentary canal, shows that ulcer pain is present even without gastric acidity, and furthermore that the pain can be controlled (in the presence of gastric acidity), not only by the administration of alkalies, but by actually putting acid into the stomach. In fact "anything and everything we put into the stomach (warm or cold water, acids, alkalies, food, mechanical stimulation) temporarily inhibits the stomach tonus and contractions." It is this inhibition of contractions, therefore,

[1] Read before the Medical Society of the County of New York, February 26, 1923.

which control the ulcer pain. If this contention can be upheld it should have a far-reaching effect on the medical as well as the surgical treatment of peptic ulcer.

Although my subject is the use of gastro-enterostomy in the treatment of peptic ulcer, I want also to say a word about the abuse of the operation, its indiscriminate use when an ulcer cannot be demonstrated, as well as some of the other of its indications besides chronic ulcer. Gastro-enterostomy inadvisedly performed in the absence of a lesion, intrinsic to the stomach or the duodenum, may result in very positive derangement of the digestive function which did not exist before.

Gastro-enterostomy for ulcer is both a physiological and an anatomical operation. In gastric or duodenal ulcer, there is a lack of balance between the gastric acids and the duodenal alkalies which results in spasm of the pyloric sphincter. In gastro-enterostomy we have an operation whereby the patient makes use of his own alkalies for neutralization of the increased acid secretion, while at the same time the new opening provides an outlet for the food taken into the stomach. Gastro-enterostomy acts mechanically and in no other way, declares Moynihan.

The motor and secretory functions of the stomach show marked changes following the operation for gastro-enterostomy. The physical alkalinization occurs as may be shown by the constant presence of bile in the gastric contents after the existence of the new stoma.

Paterson has shown that the total gastric acidity is lowered about thirty points after gastro-enterostomy, his work having been based on a series of cases in which only gastro-enterostomy was done. Guy, in studying the effect of gastro-enterostomy on gastric function, declares the motor and secretory functions of the stomach are profoundly modified by the existence of the new stoma, which permits a readier exit for the food and a freer entrance for the duodenal contents. The fractional test meal shows that bile is constantly present in the stomach after gastro-enterostomy. Since bile is present, it must be assumed that the pancreatic juice has an equally free means of entrance although it cannot be detected by any simple chemical test.

Notwithstanding the fact that in some cases of gastro-enterostomy the stoma is apparently functionless as regards foods, bile is found in every specimen of gastric contents examined. There is some difference of opinion as to whether the emptying time of the stomach is increased or decreased following gastro-enterostomy, but I feel that after gastro-enterostomy, properly performed, for a justifiable indication, the stomach will be found to empty more rapidly than normally.

Among the surgeons who operate comparatively frequently for gastric ulcer, there is still a diversity of opinion as to whether a gastro-enterostomy alone should be done, whether it should be accompanied by excision or artificial perforation of the ulcer by cautery and closure, or a pylorectomy, or a subtotal gastrectomy be made. With the exception of very small ulcers which can be excised and the closure made without in any way altering the normal motor function, I think excision of the ulcer plus a gastro-enterostomy is the accepted procedure for the majority of surgeons, especially when that portion of the digestive tract in which the ulcer is located is freely deliverable. Irrespective of whether or not a true peptic ulcer ever undergoes carcinomatous degeneration, it is better to remove the ulcer with the surrounding indurated wall, since an early carcinomatous ulcer is indistinguishable from a chronic callous ulcer. Wilensky and Thalheimer have pointed out that of 748 ulcerated gastric lesions studied by them, all of which appeared benign grossly, 18.7 per cent were proved by the microscope to be malignant. In the laboratory of the Lankenau Hospital, under the directorship of Dr. Stanley P. Reimann, carcinoma engrafted upon gastric ulcer has been found in 30 to 35 per cent of cases. Since ulcer of the duodenum very rarely develops into cancer, it is not so imperative to destroy or remove this lesion, although perforation and hæmorrhage must be kept in mind as possible complications, the former occurring in a comparatively high percentage of cases. It is known that a peptic ulcer may perforate even after gastro-enterostomy alone has been performed, and I feel sure that a definite percentage of the marginal ulcers which occur following gastro-enteros-

tomy are due to a lack of thoroughness in dealing with the initial lesion which remains as a focus of infection.

It is my practice to excise or destroy by cautery the small duodenal ulcer and make a gastro-enterostomy. In the large ulcer of the first portion of the duodenum, where the wall of the bowel is infiltrated wide of the ulcer, I make a pylorectomy, including in the section the pylorus and the duodenum to below the point of infiltration, and follow with a posterior gastro-enterostomy.

Gastro-enterostomy alone is indicated in cicatricial obstruction of the pylorus and in extensive, benign ulcerative disease of the pyloric end of the stomach, where the condition of the patient will not warrant a more extensive operation. Subtotal gastrectomy should be considered later, yet we must not lose sight of the fact that absorption and dissipation of the mass have been known to take place in not a few cases. I have been able to prove this in patients upon whom I have made a gastro-enterostomy and later had occasion to open the abdomen for other conditions. Taking advantage of this opportunity to examine the site of the former pyloric mass, I have found it absent and the stomach grossly restored to normal. Doubtless many other surgeons have had a similar experience.

Gastro-enterostomy alone is indicated in large ulcers involving much of the lesser curvature or of the posterior wall of the stomach, with adhesions to the liver or the pancreas, which forbid excision or subtotal gastrectomy. In ulcer of the cardiac end of the stomach, not amenable to excision or destruction by cautery, gastro-enterostomy is occasionally performed. While I believe operation offers something in this class of cases, the results are not nearly so satisfactory as in the aforementioned conditions.

Gastro-enterostomy alone, I would also say, is indicated in gastric or duodenal ulcer with recurrent hæmorrhage which forbids removal of the ulcer. This, with blood transfusion, will tide the patient over the critical period and make removal of the ulcer at a subsequent time a safer procedure. Cases of this kind are, in my experience, rare, still I have seen an occasional one.

In obstruction of the pylorus or the duodenum, due to adhesions to the liver, as sometimes occurs after removal of the gall bladder or after operation upon the common bile duct, gastro-enterostomy will provide a functioning stoma resulting in relief of symptoms; in hour-glass stomach where the constriction is close to the pylorus and the pyloric pouch is small, the new opening, of course, should be made in the cardiac pouch, close to the site of the constriction. There are instances on record where two gastro-enterostomies have been made in hour-glass stomach, one in each pouch, but I have never done it.

Gastro-enterostomy is rarely necessary in the operation for saddle-back ulcer of the lesser curvature causing hour-glass constriction as circular resection suffices in practically all cases; but it may occasionally be best to make a gastro-enterostomy after the circular resection.

Where the induration of the walls of the stomach is widespread, a subtotal gastrectomy will be the better operation. In case of bleeding stomach, caused by toxic erosions (Dieulafoy's ulcer) gastro-enterostomy has been done. Personally I have used it in only one instance, with a negative result.

In extreme chronic gastric dilatation, in the absence of a patulous pylorus, where there is retention, and the stomach never completely empties itself, gastro-enterostomy has given me satisfactory results.

In a very limited number of cases of leather-bottle stomach (linitis), I have had success with the operation of gastro-enterostomy alone. This is an exceptional experience, I grant, since in the great majority of cases this condition is inoperable. My first experience with the operation for this condition was reported some years ago. The patient was a doctor and a personal friend. The stomach was diffusely infiltrated and greatly reduced in size, with practically complete obstruction of the pylorus. When the stomach was exposed and palpated, I first thought that nothing but complete removal offered, but upon more careful study I concluded I could make an anterior gastro-enterostomy, which I did. The patient lived 15 months in comfort, finally dying of carcinoma. My experience with these "leather

bottle" stomachs is that they are all carcinomatous. I have seen a number of these cases and in nearly all I have been unable to do anything. This leads me to say that gastro-enterostomy alone in carcinoma is not by any means a very satisfactory procedure, yet sometimes it does prolong life a short time. When operation is feasible, the general condition of the patient allowing, I very much prefer subtotal gastrectomy, making the Balfour operation, bringing the jejunum over the transverse colon rather than through an opening in the transverse mesocolon; or a Moynihan, short loop anterior gastro-enterostomy. The mortality in my experience has been less after the radical operation than after gastro-enterostomy alone; the postoperative life is longer and the morbidity less.

For some time it has been taught that a perforated ulcer is a cured ulcer, and as a result of this teaching it has become the accepted practice merely to close the perforation. I believe that this practice carries with it definite potential dangers, since we now know that perforation does not always cure the ulcer and, secondly, we cannot be sure that a latent carcinoma is not present in the margins of the ulcer crater. It is for the latter reason particularly that I prefer excision of any ulcer to perforation by the cautery. I am a confirmed advocate of gastro-enterostomy as a part of the treatment for perforated ulcers where the patient's condition permits. I do not agree with those surgeons who say that it is unwise to do a gastro-enterostomy for a condition that is going to be cured anyhow, since I have had to re-operate on too many patients that were treated by the simpler method.

The best results from gastro-enterostomy are to be expected, first, in that group of cases where the stoma furnishes a new outlet, necessitated by cicatricial pyloric stenosis, and, secondly, in those cases where intense pylorospasm so upsets Meltzer's law of contrary innervation as symptomatically to simulate the first condition. In these cases relief by gastro-enterostomy is in direct ratio to the extent and duration of the pathological physiology.

We do have failures following excision of the ulcer or excision plus gastro-enterostomy. Some of these failures may be due to neglect in removing a diseased gall bladder or appendix at the time of the operation. I do not believe that any operation for peptic ulcer will give uniformly satisfactory results unless primary foci of infection are sought for and removed. This fact is too frequently forgotten by many surgeons. Or a stoma wrongly placed, an obstruction of one of the jejunal limbs, a kink or a spur, or too small a stoma, all of which are errors in technique, may be the cause of persistence or aggravation of symptoms. Recrudescence of the symptoms may also be attributed to the development of a new ulcer in the stomach or duodenum or of a marginal ulcer, or the reactivation of a healed or partially healed ulcer.

I have said nothing about gastro-enterostomy in infantile pyloric stenosis, as this operation has been replaced by Rammstedt's method. I may remark, however, that where the duodenum has been accidentally opened in making the Rammstedt, as has been known to occur, gastro-enterostomy may be required.

I have purposely not discussed operation in acute or subacute peptic ulcer. I am fully in accord with my medical friends, that the acute and the subacute peptic ulcers belong to them, but when they become chronic, which I believe the most of them do, they are then surgical and to treat them medically is to court disaster.

A word as to medical treatment of ulcer. For the reasons which I have given you for my belief in excision of the ulcer, it must be evident to you that I do not entirely agree with Dr. Sippy and Dr. Einhorn that it is safe to temporize with chronic gastric or duodenal ulcer. The complications of hæmorrhage, perforation, and malignant degeneration are too frequent and too serious to allow procrastination in radical treatment. There are numerous reasons why medical treatment does not permanently cure ulcers. That the methods in vogue relieve the symptoms for the time being there is little doubt. But even taking it for granted that there is definite clinical and X-ray evidence of the existence of the ulcer, there is no other means than by opening up the abdomen, of demonstrating the underlying focus or foci of infection or of possibly associated infections. It is a well-known fact that in a very large per-

centage of cases the appendix is found definitely diseased and with a strong suspicion as to the origin of the infection in the stomach or the duodenum which led to the development of ulcer. In a small, but still very appreciable, number of instances the gall bladder is likewise involved. It is in these cases that surgery offers the better chance for a cure, inasmuch as these organs can be dealt with at the same time as the actual ulcerous lesion. If the internist believes in treating oral or throat and nose sepsis as possible foci of abdominal infections, he must also recognize the logic of removing intra-abdominal sources of infection.

Medical treatment of chronic ulcer fails also because the chronic induration prevents the approximation of the mucosa, and at the most it allows healing only by the formation of cicatricial tissue which is less resistant, and therefore more easily attacked by the acid gastric secretion. It may fail also because it is based on the assumption that the patient, whatever his economic status, will co-operate in the prolonged and elaborate dietary regimen necessary to correct the condition as far as possible. Einhorn claims good results in feeding through the retained duodenal bucket, the rationale being rest of the ulcer. I cannot help repeating what I have so often said that it is after operation that the medical treatment of ulcer is in place. The co-operation of the internist with the surgeon is necessary following operation; for too frequently a good surgical result has been forfeited because of dietetic indiscretions of the neglected patient. Bastedo is correct when he says we must no longer tolerate the surgeon who places an ulcer patient on a bulky or heavy diet shortly after operation. The modern surgeon will look for improvement in his results not so much to refinement in surgical technique as to increased postoperative co-operation from the internist.

SURGICAL SIGNIFICANCE OF MESENTERIC LYMPHADENITIS[1]

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THE object of this paper is not the discussion of the ordinary and rather rare "tabes mesentericus," in which the intestinal mesentery is occupied by large, definitely tuberculous lymph nodes, often caseated or calcified. On the contrary, the intention is to consider a form of lymphadenitis characterized by the presence of numerous small, soft nodes, which, although common, is not as frequently recognized by surgeons as its importance demands. In fact, I have been unable to find any reference to it in most American textbooks on surgery or current surgical literature. The only article I have seen that deals comprehensively with the subject from a surgical standpoint is by J. W. Struthers.[2]

PATHOLOGY

The essential feature is a multiple enlargement of the lymph nodes in the mesentery of the small intestine, especially of the lower ileum. Involvement of the nodes in connection with the cæcum and ascending colon is much less frequent. They seldom are much larger than a large pea, are quite uniformly soft, and without external evidence of acute inflammation. The peritoneal covering remains smooth and uninvolved, although the mesentery itself may be thickened. There often is considerable clear fluid in the abdomen, sometimes enough to fill the small pelvis.

These enlarged nodes can be felt as smooth nodules and seen as small reddish areas scattered profusely through the mesentery. They usually are present in greater number toward the root of the mesentery.

The source of infection manifestly is within the intestine, but there usually is no reason to suppose that ulceration exists, tuberculous or otherwise. I am inclined to believe, with Struthers, that the infective agent gains entrance to the nodes by absorption from the normal, possibly "catarrhal" mucosa, perhaps following the ingestion of contaminated milk or other food.

Frequently I have removed nodes for laboratory investigation. Some of them revealed a simple hyperplasia and others exhibited evidences of tuberculosis. In a number of instances guinea pigs were inoculated, some of which developed tuberculosis while in others the result was negative.[3] I am inclined to believe, however, that if a sufficient number of glands had been tested, a large majority would have been found to be tuberculous. In fact, the situation, perhaps, is similar to that which exists in lymphadenitis of other regions, for instance the neck, where some of the nodes are frankly tuberculous and others merely enlarged "in sympathy"—possibly from the irritation of toxins.

It is probable that the disease represents the first stage of an ordinary tabes mesentericus, and in fact I occasionally have seen a few caseous and calcified nodes among a host of small, soft ones. But, because of the rarity of fully-developed tabes and the frequency of the form under discussion, we must assume that the disease is usually self-limited and seldom develops into the more rare, but better known type. Nevertheless, it should not be lost sight of that the two affections may be entirely separate entities, occasionally associated with each other.

It has not been demonstrated, as far as I know, that the tuberculous infection is of the bovine type; but I suspect that this is true, and that the bacilli are derived from milk or other contaminated foods.

The disease is found mainly in children of both sexes, although seen occasionally in young adults. Statistics, derived from the postmortem records of large institutions, seem to show that it is much more frequent in some localities than in others. It may be associated with rickets.

[2] Edinburgh M.J., 1921, xxvii, 22.

[3] This pathological work was skilfully carried out by Dr. Helen Craig, in the laboratory of St. Joseph's Hospital, Denver.

[1] Read at a meeting of the Western Surgical Association, Minneapolis, December, 1922.

In none of my cases have I detected tuberculosis elsewhere in the body, and Struthers reports a similar experience; but I can see no reason why this should universally be true.

SYMPTOMS[1]

Frequently these are so characteristic that it seems as if a pre-operative diagnosis should easily be made; but I have seldom been able to do this, because, perhaps, of a tendency to think of appendicitis before considering anything else.

There is *abdominal pain*, usually somewhat diffuse, but with a predilection for the right lower quadrant, due, perhaps, to the fact that the attachment of the affected mesentery runs obliquely in that direction. This attachment to the posterior abdominal wall may also have to do with the frequency with which the pain seems to run through into the back. It usually is not severe and often quite difficult to locate with exactness.

Distinct *abdominal colics* frequently occur, which come and go quickly, without apparent cause. These probably are produced by spasm of the bowel—a spastic ileus, as it were. During operations I frequently have observed the ileum go into violent spastic contraction at a mere touch.

The explanation of this probably has to do with irritability of the mesenteric nerves, produced by the enlarged lymph nodes and other mesenteric abnormalities. In fact, my observations have impressed me with the idea of an unusually "irritable abdomen," manifested particularly in the intestines, the pylorus, and the muscles of the abdominal wall.

These colics, I believe, may be regarded as a valuable diagnostic symptom, and when they are present they should lead one to suspect mesenteric lymphadenitis.

It is interesting to speculate, in this connection, how much mesenteric lymphadenitis may have to do with intussusception; for, as is well known, this almost always is preceded by local spastic contractions.

Abdominal tenderness is always present, but it is more diffuse and not so pronounced as is usual in appendicitis. Its general location is toward the right lower quadrant, for the same reason that this is the principal seat of pain.

Abdominal rigidity is not a prominent feature unless there is a coincident appendicitis. Like pain and tenderness it is more or less diffuse, but with a tendency toward the right side.

A moderate elevation of temperature is often observed. It seldom goes higher than 99° to 100°, and is not accompanied by chills. It may persist for weeks or months.

Loss of energy and flesh are quite constant and occasionally there are severe, prolonged headaches, perhaps due to some form of toxæmia. In one patient, a girl 17, a toxic blindness developed in one eye.

Various gastro-intestinal disturbances are common, such as loss of appetite, nausea, pyloric spasm, flatulence, constipation, and occasionally diarrhœa.

COURSE AND DIAGNOSIS

In some instances the course of the disease is acute, as in most of Struthers' cases, while at other times it is more or less chronic, as in the great majority of my own observations.

The similarity of symptoms is such that a differentiation from appendicitis is difficult and, with our present knowledge, often impossible. But even when the diagnosis is highly probable, one would hardly be justified in withholding an operation for fear of making a regrettable mistake.

Looking at the question broadly, when one encounters a child with indefinite abdominal pain, tenderness and rigidity, manifesting themselves mostly in the right lower quadrant, with digestive symptoms, loss of energy, and perhaps a moderate rise in temperature, one should suspect a possible mesenteric lymphadenitis, especially if the symptoms persist for several weeks or months and are accompanied by frequent intestinal colics.

Since there is an apparent lack of knowledge of the significance of the disease, or even of its existence, it undoubtedly is often overlooked, in spite of its frequent occurrence, thus adding one more to the multitude of troubles in the right abdomen which so often mystify

[1] Dr. J. N. Hall has helped me much in the elucidation of both symptoms and diagnosis.

and baffle the surgeon. There is room for abundant speculation regarding the possible inter-relationship of chronic appendicitis, mesenteric lymphadenitis, movable cæcum, and the various bands, membranes and kinks infesting this part of the abdominal cavity.

TREATMENT

Primarily this must be surgical, because of the ever-present suspicion of appendicitis; but fortunately, according to my own experience and that of Struthers, recovery, at least symptomatic, usually follows a laparotomy, much as it does in tuberculous peritonitis.

When the diagnosis is once assured by opening the abdomen, appropriate medical and hygienic measures undoubtedly are in place and may be of much benefit.

One of my cases furnishes a typical example of the effects of abdominal section followed by medical supervision:

A boy, age 12, had been sick for a year with abdominal symptoms as previously described, combined with headaches, slight fever, and loss of energy, so that he was unfitted for either play or study. At one time he had been treated for "walking typhoid." An operation revealed marked mesenteric lymphadenitis, with considerable fluid in the peritoneal cavity. The appendix was practically negative, and there were no intestinal "kinks" or adhesions. A lymph node subjected to the guinea pig test was shown to be tuberculous. Following the laparotomy the symptoms rapidly disappeared, so that the boy returned to school and resumed his normal activities. Over a year later he was still in excellent condition.

SUMMARY

1. Mesenteric lymphadenitis is a common disease of children and young adults, which has received too little attention from surgeons.

2. It is characterized by enlargement of numerous lymph nodes, usually small and soft; the infecting agent being, in many instances, the tubercle bacillus, presumably of the bovine type.

3. The most prominent symptoms are: moderate pain, tenderness and rigidity, mostly in the right lower quadrant of the abdomen, often associated with slight fever, headaches, occasional colics, various gastro-intestinal symptoms, and loss of weight and energy.

4. The disease is nearly always confused with appendicitis.

5. Because surgeons are unfamiliar with the trouble, it is seldom recognized during operations.

6. It has a strong tendency toward recovery, at least symptomatically following laparotomy.

AN EXPERIMENTAL ANATOMICAL INVESTIGATION OF THE BLOOD AND BILE CHANNELS OF THE LIVER

With Special Reference to the Compensatory Arterial Circulation of the Liver in its Relation to Surgical Ligation of the Hepatic Artery—Report of a Case of Arteriosclerotic Aneurism of the Gastroduodenal Artery[1]

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In 1916 Dr. Louis Gross working in these laboratories elaborated an efficient and simple technique for the reconstruction of the vascular system of organs with which he obtained excellent results, especially in his work on renal and cardiac circulations. He also prepared in this manner instructive preparations of lungs, placentæ, and livers. By thus shedding new light upon the distribution of blood vessels within organs, Gross opened an interesting and important field for further investigation into the physiological and pathological architecture of organs and its relation to normal and abnormal function.

This investigation was undertaken in the hope that it might thus be possible to contribute something to an accurate knowledge of the normal and abnormal distribution of the blood and bile channels of the liver.

TECHNIQUE

A complete description of the apparatus and of the technique of injection is given in Gross' monograph on *The Blood Supply to the Heart.* Briefly it consists of injecting an emulsion of barium sulphate in gelatine (in an injection cabinet, provided for this purpose) and making stereoscopic X-ray pictures of the injected vascular tree. Blood vessels are previously washed out thoroughly with physiological saline heated to 37° C. The apparatus provides control over standard conditions of temperature and pressure so that a series of organs may be injected under uniform conditions. Evidence obtained from stereoscopic views is correlated with that derived from gross dissection and microscopic serial sections. Dissection is greatly facilitated by previously clearing the organ, using a modified Spalteholz method.

In removing the liver from a human subject at autopsy for the purpose of injecting one or other of its systems of channels, it is desirable to include in the specimen, the entire diaphragm, the ostium of the inferior vena cava into the right auricle, the upper third of the abdominal aorta, and at least 1 inch of the common bile duct and of the portal vein. It is advisable to proceed with the injection within 36 hours after death, i.e., before the vessels become autolyzed. When either the hepatic artery or portal vein is to be injected, both these vessels are washed out with physiological saline heated to 37° C. For an adult liver about 5 to 8 gallons of saline, injected continuously at a pressure of 200 millimeters of mercury, are required completely to rid the vessels of blood clots. The washings flow out through the hepatic veins. Occasional light kneading of the liver helps to break up postmortem clots. When, even with the kneading, the washings from the hepatic veins are no longer blood-stained, it may be assumed that the vessels are cleared of blood. The warm saline also causes relaxation of the musculature in walls of the smaller vessels. During the saline injection, the gall bladder gradually becomes distended and when the limit of expansion of its walls is reached, thin, bile-stained saline very slowly flows from the common duct. The accumulation of fluid in the gall bladder is no doubt due, first, to the permeability of the hepatic cells for the saline, and, second, to the permeability of the mucous membranes of the bile ducts and of the gall bladder, which receive arterial blood through branches of the hepatic artery and drain their venous blood into the portal vein.

If it is proposed to inject the hepatic veins then a large cannula, 1.0 to 1.5 centimeters in diameter, is tied into the inferior vena cava

[1] With the aid of a grant from the Cooper Fund.

at its entrance into the right auricle while the vein is ligated inferiorly just below its attachment to the inferior surface of the right lobe of the liver. Through this cannula saline is injected until the washings draining out of the portal vein and hepatic artery are clear. The gall bladder receives relatively less fluid than during injection of saline through hepatic artery or portal vein. This is explained by the fact that little or no saline enters the ducts or the gall bladder through their own walls, since the former have no radicals of the hepatic vein while the latter has only very few. Practically all the venous blood of the gall bladder and bile ducts is drained away by the vena portæ.

When the liver is completely emptied of blood and only saline circulates in its blood channels, it is of a pale grayish yellow color. De Graaf, working in 1668, injected various colored fluids, such as milk, green fluids, etc., into vessels of the liver and concluded that the color of the gland is due to the contents of the vessels. The very pale color of the liver when its vessels contain only saline, readily explains de Graaf's results.

Because of the fact that the bile-duct system ends blindly in the hepatic cells, it is not possible to wash it out. Unsuccessful attempts were made at aspirating the contents of the bile-duct system. Even with a very slow aspiration current, the vessels collapse wherever a partial vacuum is produced and thus the purpose of the procedure is defeated. The most successful injections were obtained by using livers from cachectic individuals; the bile-duct systems in these cases contain a very small amount of bile, so that a minimum of obstruction is offered to the flow of the barium emulsion.

The barium sulphate emulsion is of such a viscosity at 37° C. that it will flow into the finest precapillary vessels, but will not enter the capillaries themselves. The pressure used for injecting the emulsion into the hepatic artery is determined by the average systolic blood pressure of the individual before death; this, of course, varies for different ages and in different diseases. In order to obtain a complete injection of either of the two venous systems or of the bile ducts, the pressure is manipulated in the following manner: beginning with a pressure of 250 millimeters of mercury, this is gradually diminished to 200 which is maintained until no more air under pressure from the pressure tank is required to keep the manometer reading at 200. This indicates that the system of channels is completely injected; the emulsion has everywhere reached the smallest vessels that it will enter. Then the pressure is very gradually allowed to diminish between 20 and 30 millimeters of mercury—about the normal blood pressure in the veins—the inflow of emulsion is arrested, and the organ immersed in ice cold 10 per cent formalin. In this way undue distention of the vessels is avoided.

THE ARTERIA HEPATICA[1]

The arteria hepatica communis arises as an unpaired trunk from the arteria cœliaca. At a variable point in its course, usually in the middle or last third of the distance between its origin and the porta hepatis (O. T. transverse fissure), it divides into the arteria hepatica propria and the arteria gastroduodenalis. Shortly after its origin, the former gives off the arteria gastrica dextra from its right side. The position of the bifurcation of the arteria hepatica propria into rami dexter and sinister is variable; in the 55 human livers which form the subject of this study the bifurcation occurred in the porta hepatis, near the posterior border of the lobus quadratus in 22, between the porta hepatis and the inferior margin of the lobus quadratus in 19, and at a variable point between this margin and the cœliac axis in the remaining 14 cases. The ramus dexter continued as a single vessel until after its entrance into the liver substance in 41 cases and it divided into a superior and an inferior branch in the porta hepatis in 14 cases. In two of the latter instances, the inferior branch again divided into two vessels, the inferior of which pierced the liver substance somewhat anteriorly to its

[1] For instructive diagrams of the origin and distribution of the arteriæ phrenicæ, arteria cœliaca and arteria mesenterica superior, see references 5, 12, 31, and 39. The diagrams in all these references lack one important detail, namely, they do not show sufficient anastomoses between gastric and duodenal arteries and arterioles. In several injections of the stomach and duodenum made by the author and also in those of fetuses by Dr. Arnold Branch, using the same technique, the arteries and arterioles in the entire gastro-intestinal tract anastomose with each other very freely in all instances. These anastomoses are quite as extensive as those seen beneath Glisson's capsule (see Figs. 5 and 10).

fellow. The ramus sinister remained single during its entire course in the porta hepatis in 42 cases, and bifurcated into a superior and an inferior branch in 13, and in one the inferior branch again divided into two vessels.

Small arteries, 0.2 to 1.0 in diameter, are given off by the propria to the omental tissue of the ligamentum hepatogastricum, and to the walls of the vena portæ and ductus choledochus (O. T. common bile duct). Similar arteries proceed from the rami dexter and sinister to the tissues and structures in the porta hepatis. These small vessels anastomose with each other very freely. In 5 cases the propria, at, or just before, its bifurcation into rami dexter and sinister gave off one or two larger vessels, 1.5 to 3 millimeters in diameter, to the lobus caudatus. Both rami supplied similar sized vessels to the lobus caudatus in all of the 55 livers. The large branch to the lobus quadratus which arises from the ramus sinister in all but 4 cases, also gave, in 26 instances, one or two quite large vessels (1.0 to 2.0 millimeters in diameter) to the lobus caudatus. The arteria cystica which supplies the gall bladder came off from the ramus dexter itself in 46, and from the first inferior branch of this ramus in the remaining 9 cases. In one of the latter instances, the superior branch of the ramus dexter also gave a vessel 2.0 millimeters in diameter to the superior surface of the gall bladder. All these arteries, arising in the porta hepatis, distribute small vessels, 0.3 to 0.5 millimeters in diameter, to the tissues of the porta, in which they anastomose extensively. Through these anastomoses, a bridge is formed between the lumina of the rami dexter and sinister. The ramus sinister itself and its branches to the lobus caudatus supply vessels to the tissues in the fossa for the ductus venosus; these vessels proceed to the postero-superior surface of the liver where they ramify in the region of the inferior vena cava and diaphragm, anastomosing with similar arterial vessels from other sources. The ramus sinister itself and the artery to the lobus quadratus give branches to the ligamentum teres, which form abundant anastomoses with each other.

In order to find and trace anomalies in the origin and distribution of the larger vessels, the entire course of the arteria hepatica communis must be examined. Unfortunately this was not done in all cases, so that the anomalies herein reported do not represent the total for 55 cases. In one case the gastroduodenalis arose on the right side of the bifurcation into the rami dexter and sinister as a large branch 7 millimeters in diameter. In another case the arteria gastrica dextra (see Fig. 4) came off from the propria about 1 centimeter before the latter's bifurcation, while in a third instance this vessel was given off by the ramus dexter, 2 centimeters distal to its origin. (The ramus dexter and ramus sinister have been reported to arise separately from different branches of the tripus halleria—arteria gastrica sinistra, arteria lienialis and arteria hepatica—from the arteria mesenterica superior or its branches, and it is not impossible that the arteria hepatica communis or any of its branches may arise directly from the aorta.) In 11 cases a small (1.0 to 3.0 millimeters in diameter) arteria hepatica accessoria was found coursing anteriorly toward the fossa of the ductus venosus and into the lobus sinister (8) or the lobus caudatus (3). The origin of this artery varied greatly. In 4 cases it came from the arteria cœliaca; in one from the arteria phrenica sinistra inferior, in another from the arteria phrenica dextra inferior, in another from the arteria gastrica sinistra, and in the seventh instance two arteriæ accessoriæ hepaticæ arose from the arteria hepatica communis about 1 centimeter beyond its origin. In the remaining 4 cases it was severed and could not be traced to its origin. Henle refers to a case in which there were three hepatic arteries, one of which arose from the arteria gastrica sinistra, a second from the arteria cœliaca, while the third came from the arteria mesenterica superior. We consider the artery which arose from the arteria gastrica sinistra in our case as an arteria hepatica accessoria, because the propria in this instance was present and bifurcated in a perfectly normal manner. Henle also states that the ramus sinister arteriæ hepaticæ quite frequently arises from the arteria gastrica sinistra.

Twenty-six livers were taken from individuals between the ages of 40 and 80, in all

of whom the aorta showed various degrees of arteriosclerosis. The arteria hepatica showed fatty intimal changes in 12 cases and some calcification occurred in two of these; in the remaining 43 instances, including 14 from individuals between 40 and 80 years old, the arteria hepatica gave no evidence of arteriosclerotic changes.

ARTERIOSCLEROTIC ANEURISM OF ARTERIA GASTRODUODENALIS

While examining the branches of the arteria cœliaca, at the autopsy of a woman aged 76, on exposing the entire length of the arteria gastroduodenalis a small aneurism the size of a pea was found situated 1 centimeter proximal to the mesenteric border of the duodenum (Fig. 1). The external surface of the aneurism was pale yellowish white, and perfectly round and smooth. On palpation its distal wall was found to be very firm. The lumen of the vessel was exposed by cutting it on the side opposite to that from which the aneurism projected. The neck of the aneurism was perfectly round and smooth and measured 3.5 millimeters in diameter. The interior of the sac was lined with a coat of calcareous material which was much thicker on the distal than on the proximal wall.

The cause of death in this case was failure of the right side of the heart due to severe extensive fatty degeneration of the myocardium. The aorta and coronary arteries were markedly arteriosclerotic. The branches of the arteria cœliaca showed only slight fatty intimal changes. There was no history, nor any evidence of syphilis.

DISTRIBUTION OF THE RAMUS DEXTER AND RAMUS SINISTER ARTERIÆ HEPATICÆ PROPRIÆ WITHIN THE LIVER

The hepatic artery was injected in 37 human livers; the distribution of its branches within the liver was studied principally with the aid of the stereoscopic X-ray plates. Several livers were dissected in order to corroborate evidence obtained from the stereoscopic pictures.

The branching of the vessels is strictly dichotomous; the angles formed by branches with their main stems vary from 60° to 90°. The plastic, stereoscopic view of the entire arterial system resembles very closely a spreading tree.

The vessels gradually diminish in size. Considering the ramus dexter or sinister as a branch of the first order, it is found that the injection mass has reached the seventh order of branching—the precapillary arteriole, which is large enough to be visible to the naked eye. The hepatic arterial tree in livers of individuals in the first four decades of life shows little or no tortuosity of its branches and resembles a maple sugar tree as it appears in the fall without its leaves (Figs. 3–7, and 8). In the fifth decade tortuosity is quite evident, but is not very marked (Figs. 4 and 5); in the sixth and seventh decades, it is very prominent so that the entire arterial system resembles a bare old apple tree (Fig. 9). Where tortuosity was present to any appreciable degree it appeared to be somewhat more marked in the left lobe than in the right. This gradual development of a tortuous course with advancing age may be due to a loss of the elasticity of the vessels, or to changes in the fibrous connective-tissue stroma of the liver, or to both these influences.

Either just before or, as occurs more frequently, soon after it enters the substance of the right lobe, the ramus dexter bifurcates into a superior branch and an inferior branch. In our series the former branch is the smaller and the latter is the larger in 89 per cent of cases; in these instances the superior supplies the left posterosuperior fourth of the right lobe, i.e., a portion of the lobus caudatus and the regions posterior and to the right of it. The inferior branch either divides again into two equal sized branches which supply the remaining three-fourths of the lobe, or else it pursues a curved oblique course,—with its convex side directed inferiorly—toward the right superior corner of the lobe, giving off four to six large vessels (third, fourth, and fifth order) at regular intervals of about 2 centimeters apart. The lobus caudatus and the liver substance posterosuperior to it receive branches from the main stem of the ramus dexter both before and after it enters the liver substance, from the superior branch of the ramus dexter and from the first branch of

the inferior; the last vessel distributes itself mainly to liver substance in the region of the gall bladder, i.e., superior and to the right of it. In 7 per cent of the cases the superior is the larger and the inferior the smaller vessel. In these cases the superior gives off a large branch which distributes itself very much in the same manner as the superior branch in the former (89 per cent) series; it then pursues a slightly curved course, with the convex side turned superiorly, giving off large branches which supply the posterosuperior two-thirds or three-fourths of the lobe. The remainder of the lobe receives branches from the smaller inferior branch which, as in the 89 per cent series, sends vessels to the regions around the gall bladder above and to the right of it. In the remaining 4 per cent of cases both branches are of about equal size and supply about equal parts of the lobe. They also distribute vessels to the lobus caudatus and gall-bladder regions similarly to the superior and inferior branches in the 89 per cent and 7 per cent series.

All the large and some of the smaller branches which arise within the liver terminate by a great number of small vessels (sixth and seventh order) near the surface of the liver. Some of these small vessels reach the surface where they divide (not strictly dichotomously) into numerous branches which form an intricate network of anastomoses that is present over the entire surface of the lobe. These anastomosing subcapsular vessels lie in little shallow grooves in the liver surface and are so intimately attached to Glisson's capsule that when this is stripped practically all the vessels accompany it (Fig. 6), leaving a network of fine grooves on the surface of the liver substance. The smaller vessels which terminate within the liver do not participate in the subcapsular anastomoses and are therefore end-arteries. The numerous small arteries and arterioles which are given off by every hepatic arterial branch to the fibrous sheath of the portal canal and to the structures within it anastomose very freely with each other.

The arteria cystica, after a course of 1 to 3 centimeters, first, in the vicinity of the cystic duct and then on the inferior or superior surface of the gall bladder, divides into two main branches, a right and a left. The former was the larger of the two in 70 per cent of cases, the latter in 20 per cent and they were of about equal size in 10 per cent. The main branch was found on the superior surface in 60 per cent of the cases, and on the inferior surface in the remaining 40 per cent. The vessels which come off from the main branch and from its two large branches anastomose very freely together. When the gall bladder is distended, the anastomosing vessels are seen to form a complete system of larger and smaller squares (Fig. 2), giving the appearance of a spider's web, if it were arranged in the shape of a gall bladder. When the gall bladder is collapsed these vessels appear very tortuous (Figs. 4, 5, and 7). On the superior surface of the gall bladder, where it is intimately attached to liver substance, branches of the cystic artery enter the liver and vessels from the first branch of the inferior branch of the ramus dexter, enter the gall-bladder wall, and anastomose with the arteria cystica vessels. From beneath the peritoneum-covered surfaces of the gall bladder, vessels proceed onto the neighboring surfaces of the lobus quadratus and lobus dexter, and anastomose with the other subcapsular vessels in these regions.

The largest artery to the lobus quadratus came off from the ramus sinister or one of its branches in 51 of the 55 livers. In the remaining four cases, the sinistra was found to run anteriorly in the fossa for the ductus venosus and to enter the left lobe in about the middle third of this fossa after giving off only a few small branches to the surrounding connective tissues and to the lobus caudatus. In these instances the ramus dexter alone accompanied the ductus choledochus and the vena portæ in the ligamentum gastrohepaticum, and when it reached the porta hepatis it gave off a large vessel (3 to 5 millimeters in diameter) which ran to the left and entered the lobus quadratus at its posterior margin. In the series of 37 livers in which the hepatic artery was injected, the branch to the lobus quadratus arose from the ramus sinister itself in 48 per cent, from its inferior branch in 50 per cent, and from its superior branch in 2 per cent of instances. In addition to this largest vessel, the quadrate lobe also receives smaller arteries (0.5 to 2

millimeters in diameter) from the ramus sinister and both its main branches and from those of its vessels which go mainly to the lobus caudatus; also from the ramus dexter itself, but more commonly from its branches to the lobus caudatus and to liver substance in the region superior to the gall bladder. The arteria cystica invariably sends branches into the quadrate lobe.

In every case the ramus sinister or its branches send vessels to this lobe in 100 per cent, and its branch to the lobus quadratus in 14 per cent of 55 cases. The superior branch of the ramus sinister gave offsets to the lobus caudatus in 40 per cent and the inferior branch in 48 per cent of 37 instances.

It appears evident that the lobus caudatus and lobus quadratus receive arteries from both the ramus dexter and ramus sinister. Many anatomists consider the lobus caudatus and lobus quadratus as part of the lobus dexter. A careful examination of their vascular supply from the hepatic artery, the portal vein, and bile ducts has made it clear that the lobus caudatus receives the bulk of its vessels from the right main branches and the lobus quadratus from the left (Fig. 2). In 20 per cent of our cases the processus caudatus was fused with the lobus dexter, and in 80 per cent it was completely free. In 79 per cent the lobus quadratus was attached to the lobus sinister by a bridge of tissue which varied from liver substance occupying almost the entire fossa umbilicalis to a thin fibrous cord containing some small vessels which crossed this fossa in the middle third of its length; and in the remaining 21 per cent of cases the fossa was not bridged by any tissue whatsoever. It is a noteworthy fact that in all the eight infants' livers in our series, the processus caudatus was relatively large and fused with the right lobe: the lobus quadratus was also very large and presented liver substance bridging the fossa umbilicalis in no less than the posterior two-thirds of its length. If these two lobes are not to be allowed complete autonomy, that is, if they must belong to either the right or left lobes, then it appears logical from the point of view of blood supply, at least, that the "mandate" for the lobus caudatus should be accorded to the lobus dexter and that for the lobus quadratus to the lobus sinister.

The larger of the two main branches of the ramus sinister usually supplies two-thirds and less frequently three-fourths of the lobus sinister. The superior branch sends more of its vessels posteriorly and the inferior distributes its vessels more extensively in the anterior parts of the lobe. All the larger branches of both superior and inferior, and those smaller vessels which arise from the ramus sinister and its main divisions very near the surface of the liver send vessels to the surface of the liver and there distribute themselves in a similar manner to the subcapsular vessels of the right lobe. The entire liver is thus enveloped by a continuous network of subcapsular anastomosing arteries and arterioles.

It appears evident that the middle portion of the liver, namely, the region including the lobus caudatus and lobus quadratus and liver substance posterior and superior to these lobes receives arteries from both the rami (Fig. 2). Through their subcapsular anastomoses these arteries constitute an important communication between their respective parent vessels.

COLLATERAL CIRCULATION BETWEEN RAMUS DEXTER AND RAMUS SINISTER

It has long been known that obliteration of either the ramus dexter or sinister is not followed by any injury to the portion of liver substance in which the obliterated vessel distributes itself. The probable explanation that blood from the vena portæ sustains the tissues in these cases does not agree with the fact, which is generally accepted from experimental evidence, that, with a normal portal circulation and an obliterated arteria hepatica propria, total necrosis of the liver occurs (Cohnheim and Litten, Haberer, Behrend, et al.). On investigating this question it was found that by preparing the liver for a hepatic artery injection in the usual manner and then ligating either the ramus dexter or sinister, the barium sulphate emulsion being injected only through the unligatured vessel, the entire arterial tree was filled with the emulsion. Knowing that the emulsion is of

such viscosity that it will enter only precapillary vessels, it follows that the anastomoses between the two rami are made up of vessels that are larger than capillaries. These anastomoses have been referred to above; they exist among the subcapsular arteries and arterioles and those that supply the tissues of the porta hepatis and that are derived from the rami dexter and sinister or from their branches. (See Figs. 8 and 9.)

The principal vessels whose terminal branches take part in anastomoses in the vicinity of the middle portion of the liver, are as follows:

From the ramus dexter: (*a*) vessels to the tissues and structures in the porta hepatis; (*b*) vessels to the lobus caudatus given off before and after the ramus dexter enters liver substance; (*c*) the arteria cystica; (*d*) vessels which distribute themselves in the regions superior and to the right of the gall bladder; (*e*) in a small number of instances vessels to the lobus quadratus and to the tissues in the fossa umbilicalis.

From the ramus sinister: (*a*) vessels to tissues and structures in the porta hepatis; (*b*) vessels to tissues in fossa of ductus venosus and fossa umbilicalis; (*c*) the arteries to the lobus quadratus and lobus caudatus.

In addition, the entire surface of the liver is enveloped by a network of anastomosive arteries and arterioles which issue from intrahepatic branches of the rami dexter and sinister arteriæ hepaticæ propriæ.

The more exact nature of the course which the emulsion follows when the entire arterial tree is injected through one or other of the main branches of the propria was determined by the following experiment:

After preparing the liver for an hepatic artery injection, the rami dexter and sinister were severed from the propria and a cannula was inserted into each. The cannula in the ramus sinister was joined by rubber tubing to the Wolff bottle containing the barium sulphate emulsion, while the cannula in the ramus dexter was connected with a short piece of rubber tubing (10 centimeters in length). Using a pressure of 145 millimeters mercury, the emulsion was injected into the ramus sinister; almost immediately after the fluid entered the ramus, the emulsion appeared flowing from the cannula in the ramus dexter. The rubber tubing on the latter cannula was clamped and the injection continued for 3 minutes, i.e., about half the time usually required to inject completely the entire arterial tree. During the course of the injection the cannula in the ramus dexter remained filled with injection mass. As a result of this procedure the subcapsular vessels on the lobus sinister, the lobus quadratus, and those on the left side of the lobus caudatus were well injected, while on the lobus dexter and the right side of the lobus caudatus only a few scattered subcapsular vessels were seen. On examining the roentgenogram of this injection it was found that the ramus sinister and all its branches as far as the seventh order, were completely filled, but that with the exception of the vessels to the mid-portion of the liver and to the gall bladder, the ramus dexter and its branches were completely injected only as far as the fourth and fifth orders and only occasionally in scattered areas were sixth and seventh order vessels filled with emulsion. This experiment was repeated, making the injection through the ramus dexter (see Fig. 10). From these facts we conclude that after the fluid has entered the first and nearest anastomoses it passes along the course of least resistance into their larger parent vessels and then into the main ligated branch (in our experiment the ramus dexter) from which the fluid is pushed onward from behind, so to speak, into the remaining ramifications of the ligated vessel. Since the most proximal anastomoses are in the hilus, the ligated vessel becomes filled with the emulsion almost immediately after the injection is begun, indeed, before any subcapsular vessels appear injected.

These anatomical facts regarding the compensatory arterial circulation between the rami dexter and sinister suggest very strongly that in cases where one of these vessels or their branches are blocked by thrombosis or embolism, etc., the nutrition of the area supplied by the obliterated artery is maintained by a compensatory arterial circulation and not by portal blood. The fact established by experimental evidence that total obliteration of the hepatic artery with co-existing normal

Fig. 1. Arteriosclerotic aneurism of the arteria gastroduodenalis. (A-151-22, fatty degeneration of the heart with dilatation. General arteriosclerosis.) An enlarged photograph of the arteria gastroduodenalis lying upon the inferior surface of the liver. The artery was cut at the point in its course along the mesenteric border of the duodenum just distal to the aneurism which is seen in the photograph as a more brightly illuminated bulging area.

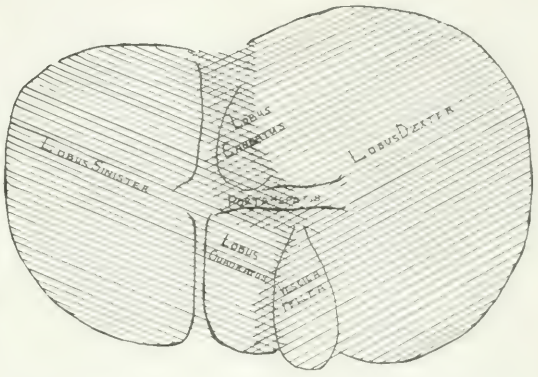

Fig. 2. The checkered areas represent those parts within the liver which are supplied by branches from both the ramus dexter and the ramus sinister of the arteria hepatica propria and vena portæ.

portal circulation was followed by complete necrosis of the liver, must be considered as strong evidence in favor of this view.

It appears, therefore, that oxygenated arterial blood is indispensable to the health and life of liver cells.

ANASTOMOSES BETWEEN HEPATIC AND PHRENIC ARTERIES

The entire diaphragm was not included in every one of the specimens injected through the hepatic artery. However, that portion of diaphragm which covers the bare area of the lobus dexter was present in all of the 37 instances and by gross dissection it was possible to find the arteria phrenica dextra inferior in every case. The phrenic vessels in all 37 instances in which the hepatic artery was injected, were invariably more or less completely filled with emulsion.

The anastomoses which are responsible for the presence of emulsion in the phrenic arteries when the hepatic arteries are injected were found to be present in the layers of peritoneum which are reflected from the liver onto the diaphragm (parts of which form the ligamentum coronarium hepatis and the ligamentum triangulare sinistra): in the areolar tissue between diaphragm and liver surface, and between the layers of reflected peritoneum, including the bare area on the posterosuperior surface of the lobus dexter: in the ligamentum falciforme hepatis: and in and around the walls of the vena cava inferior.

-in this latter region larger arterioles from both rami join with terminal vessels of phrenic arteries. These anastomoses are between small arteries and arterioles (sixth and seventh orders of branching) which pass from the liver surface into the layers of peritoneum or the areolar tissue described above and there join with similar vessels which are branches of phrenic arteries. In six of fifteen instances in which the arteria phrenica sinistra inferior was dissected, it gave a large branch which coursed in the ligamentum falciforme hepatis near its attachment to the liver, giving off arteries which anastomosed with similar ones from the intrahepatic branches of the ramus sinister. In all of the 16 cases it also gave smaller branches to this ligament which formed anastomoses with small arteries from the ramus sinister branches.

In the light of the present conception of the developmental anatomy of the liver and diaphragm, it is not at all surprising that the blood supplies of these two structures should be so intimately connected. The liver develops from two endodermal buds of the foregut. At first the endodermal cells arrange themselves to form a simple tubular gland, but as this liver "anlage" becomes partially embedded in the caudal part of the septum transversum, it acquires mesodermal tissue

Fig. 3. Arteria hepatica, second decade. (A-158-21.) Roentgenogram of the injected arterial tree in the liver of a male, age 18, who died of generalized peritonitis following perforation of a typhoid ulcer. The glass cannula *g.c.* is in the arteria hepatica propria, *p.*, near its bifurcation into ramus dexter, *d.*, and ramus sinister, *s.* The branches divide dichotomously, gradually diminish in size and they are all quite straight. The branches of the arteria cystica, *c.*, are tortuous because the gall bladder, *g.b.*, is collapsed; note how freely these branches anastomose with each other. *l.c.*, A large branch to lobus caudatus springing from the ramus dexter. *d.su.*, The superior division of the ramus dexter; *d.in.*, the inferior division of the ramus dexter which supplies about three-fourths of the right lobe. *l.q.*, A small branch of the ramus sinister to the lobus quadratus; *L.q.*, the main branch to the lobus quadratus arising from the ramus sinister; *f.u.*, branches of the ramus sinister to tissues of the fossa umbilicus; *d.v.*, branches of the ramus sinister to tissues of the fossa ductus venosus; *s.su.*, superior division of ramus sinister; *s.in.*, inferior division of ramus sinister; a^1, two branches of superior division join to form a single vessel; a^2, a branch of the distal limb of a^1, and a branch of the superior division proper join to form a single artery.

which alters its architecture. Thus by ingrowth of mesodermal tissue which in the adult liver constitutes Glisson's capsule and the stroma of the portal canals, the original simple tubular gland is completely rearranged to form a gland made up of indistinctly separated lobules of secreting cells arranged around the central veins, radicals of the hepatic vein. In addition to supplying the mesodermal tissue of the liver, this caudal portion of the septum transversum also develops into the ligamentum falciforme hepatis and the omentum minus. The intermediate portion of the septum transversum forms the diaphragmatic wall of the pericardium and its cephalic portion develops into the ventral part of the diaphragm. Thus the same mesodermal structure which develops into part of the pericardium, peritoneum, and diaphragm also supplies the liver with all its mesodermal tissue. Both on account of their intimate embryological relationship and their close apposition in the fully formed individual, it is to be expected that there would be communications between the blood vessels of the liver and of the diaphragm.

In view of the importance of these anastomoses, the nature of the blood supply to the

Fig. 4. Arteria hepatica, fifth decade. (A-6-22, male, age 55, died of bronchiectasis.) The arteries are quite tortuous, particularly in the left lobe. *a.g.d.*, Arteria gastrica dextra, anomalous origin close to bifurcation of propria; *p.h.a.*, the fine arteries and arterioles of the porta hepatis which anastomose with each other very freely; *c.*, the arteria cystica arises from ramus dexter and bifurcates into a dextrosuperior and sinistro-inferior branch which anastomose very freely with each other through their smaller branches. Due to the distended condition of the gall bladder its arteries are straight. *s.su.*, The superior division, and *s.in.*, the inferior division of the ramus sinister; *d.l.c.*, branches from the ramus dexter to the lobus caudatus; *s.l.c.*, branches from the ramus sinister to the lobus caudatus; *d.g.b.*, branches from the ramus dexter to gall-bladder region; *s.g.b.*, branches from the ramus sinister to gall-bladder region. Subcapsular branches of these vessels anastomose with branches of arteria cystica. *Dia.*, Diaphragmatic arteries injected during hepatic artery injection through anastomoses between phrenic and hepatic arteries. Arteria cystica divides into larger dextrosuperior, *c.su.*, and smaller sinistro-inferior branch, *c.in.*

diaphragm is worthy of note. This consists mainly of four arteriæ phrenicæ, namely, a dextra superior and sinistra superior which take origin from the aorta and distribute themselves to the thoracic side of the diaphragm, and a dextra inferior and sinistra inferior which do not arise in any consistently regular manner but may spring from the aorta itself or from the arteria cœliaca, arteria mesenterica superior or from any of their branches and occasionally one or the other of these phrenic arteries arises from a renal or suprarenal artery. In addition to the four arteriæ phrenicæ, the diaphragm receives quite large arteries from branches of the internal mammary (arteria pericardiophrenica, arteria musculophrenica, and arteria epigastrica superior), from the lower five to seven intercostals and from the first and second lumbar arteries. All these vessels which enter the substance of the diaphragm anastomose very freely with each other within it. In addition to

Fig. 5. (182-21, arteria hepatica, fifth decade. Female, age 53, died of peritonitis.) Note the tortuosity of the branches, most marked in the left lobe. In the stereoscopic view this picture resembles a bare old apple tree. *l.q.*, The artery to the lobus quadratus which arises from the ramus sinister simulates a figure 3 turned sideways, in its course to the lobe. *d.su.*, The superior division of the ramus dexter is smaller than *d.in.*, the inferior, but it is larger than usual. The inferior division gives off a series of four large branches at regular intervals, then terminates by dividing into two moderately large arteries. *p.s.a.*, Small arteries and arterioles are seen running parallel to their parent vessels. These supply the portal sheath and its contents. They anastomose freely with each other, as may be seen to better advantage in the stereoscopic picture and most clearly in the dissected specimen. *c.*, Arteria cystica.

anastomosing with branches of the arteria hepatica they also form communications with branches of bronchial and pleural arteries, œsophageal arteries and with capsular arteries of the suprarenals and kidneys and finally in the peritoneum of the lesser omentum, branches of the arteriæ gastrico dextra and sinistra anastomose with the diaphragmatic arteries. The presence of all these anastomoses is no less and no more surprising than the existence of the collaterals between hepatic and phrenic arteries; for the pleuræ, pericardium, muscles of the thoracic wall, the lesser omentum together with the falciform ligament and the interstitial tissue of the suprarenals and kidneys are derived from the mesoderm of the septum transversum just as the anterior portion of the diaphragm, Glisson's capsule and the interstitial tissue of the liver are developed from this embryonic structure. Thus the anastomosing diaphragmatic arteries establish far-reaching communications between branches of the thoracic and abdominal portions of the aorta.

THE VENA PORTÆ

The main tributaries of the vena portæ are the venæ mesentericæ inferior and superior and the vena lienalis. The vena portæ itself is a wide vein measuring 1.5 to 2 centimeters in diameter and about 6 to 8 centimeters in length. In the human adult, it commences at

the union of the vena mesenterica superior with the vena lienalis and ascending anteriorly to the vena cava inferior and posteriorly to the pancreas and duodenum it reaches the lower border of the foramen epiploicum (Winslow) where it passes forward in the right gastropancreatic fold of peritoneum and enters the ligamentum gastrohepaticum. In this it lies posterior to the bile duct and hepatic artery until it reaches the right third of the porta hepatis, where it widens into the sinus venæ portæ at its bifurcation into a shorter right and longer left branch. While coursing in the ligamentum gastrohepaticum, it receives the venæ gastricæ dextra and sinistra. The vena cystica joins the main stem of the vena portæ or its right branch; in our series of 55 livers, it joined the right branch in 88 per cent of cases. From the main stem from the sinus at its bifurcation and from its branches spring vessels which accompany the arteries given off by the arteria hepatica propria and its branches. Occasionally, however, branches go from the portal vein into liver substance alone and are joined by their accompanying arterial vessels only after they have pierced the liver. Branches are injected as far as the seventh order, considering the right and left main division as branches of the first order. Those of the fourth and more especially those of the fifth and sixth orders divide dichotomously into equal sized vessels forming arches with angles of about 80° to 100°. The change in size from the first to the fifth order of vessels is gradual, but from the fifth to the sixth and seventh orders more sudden (Fig. 11), as was first observed by Gross in 1919 (17).

In view of the fact that the branches of the portal vein and of the bile ducts run along together with those of the hepatic artery, it follows that the nature of their gross distribution is similar in all three systems. In the seven livers injected through the vena portæ, the right inferior branch was the larger in five and the inferior and superior were of about equal size in two instances. The left inferior was the largest in six and the superior in one instance. The large branch to the lobus quadratus invariably sprang from the left main division, while the right main division was joined by the vena cystica in every case.

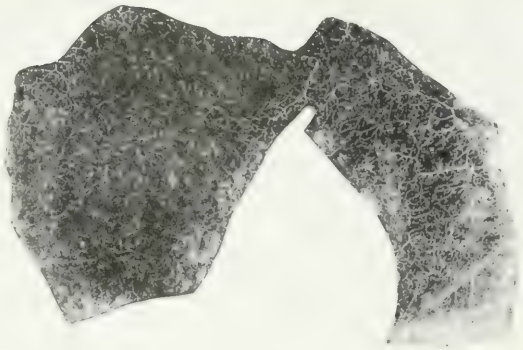

Fig. 6. Glisson's capsule. A portion of Glisson's capsule removed from the superior surface of a liver the hepatic artery of which was injected. The capsule was cleared with oil of wintergreen and then photographed. Note the abundant anastomoses of subcapsular and capsular arteries and arterioles. Where the continuity of vessels is broken the missing parts remained on the liver during the stripping off of the capsule.

The vena cystica, which drains venous blood from the gall bladder into the portal vein, courses on the anterosuperior surface of the gall bladder and between it and the liver substance along a variable length; it has two more or less equal main tributaries, one of which drains principally the gall bladder, while the other drains liver substance just above this organ. Occasionally (in two of our cases) the main vena cystica is partially embedded in liver substance and emerges only in the fossa for the gall bladder. Branches of the vena portæ which distribute themselves in the liver substance around the gall bladder send a variable number of larger and smaller veins into this organ, while both branches of the vena cystica send vessels into liver substance. The veins of the gall bladder anastomose with each other just as freely as the branches of the cystic artery (Fig. 12). Thus an anastomotic communication is formed between branches of the right and left divisions of the portal vein.

Terminal venules of the fifth, sixth, and seventh orders end beneath and in Glisson's capsule, but they do not anastomose with each other as the subcapsular arteries and arterioles do. These venules seem to end in capsular capillaries among which anastomoses must exist. Venules from the surface enter the peritoneal ligaments between the diaphragm and liver and there anastomose very freely with diaphragmatic venules, so that the

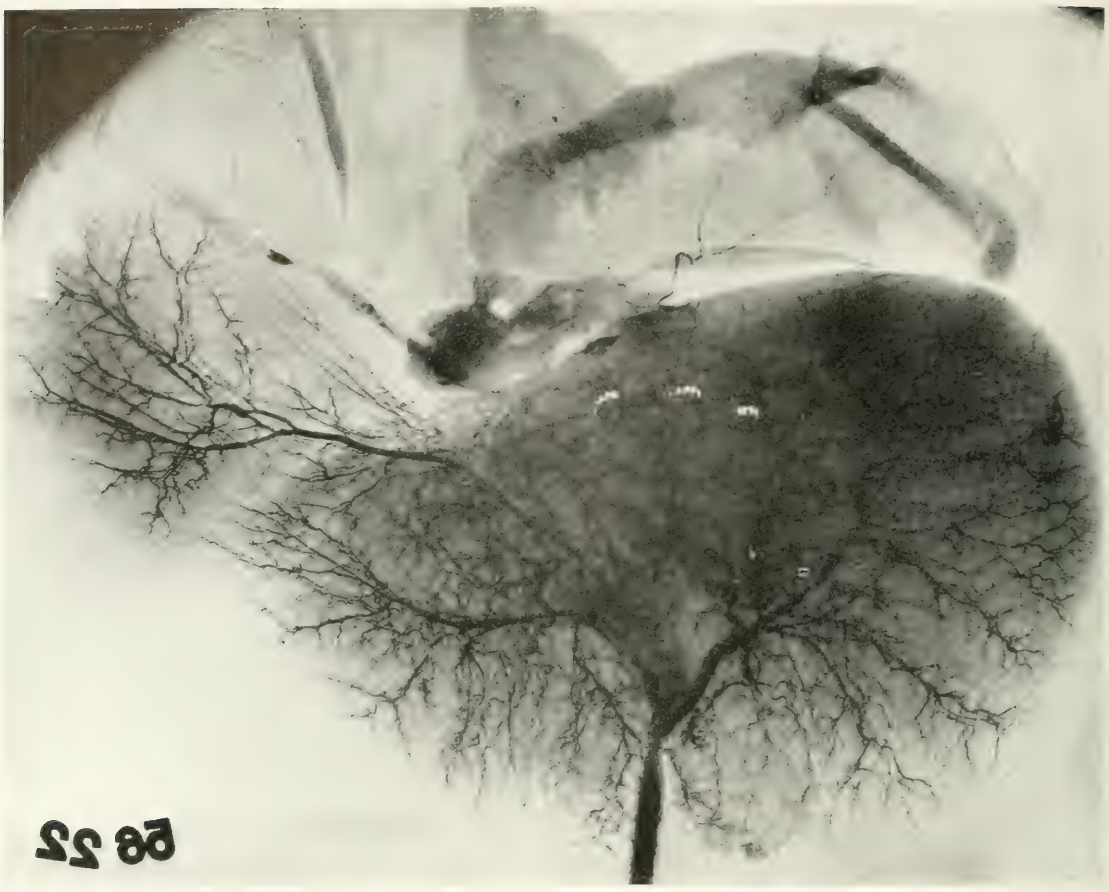

Fig. 7. Arteria hepatica, fourth decade. (A-57-22. Female, age 41, cerebral endothelioma in frontal region.) The left lobe has an appendage of normal liver substance, about the size and shape of an average adult kidney. Connecting the appendage to the left lobe is a thin, almost transparent, strip of tissue consisting of two layers of peritoneum and Glisson's capsule and some scattered small flat masses of liver substance. (One other liver with a similar but smaller appendage occurred in our series of 55 specimens.) The arterial tree was injected through the arteria hepatica propria and as the greater part of the diaphragm was still attached to the liver its arteries became injected with the fluid. Note the fine anastomoses *a*, *a*, *a*, between superficial arteries and arterioles of hepatic and phrenic origin in the coronary ligaments and also those between diaphragmatic arteries proper. *a.p.d.*, Arteria phrenica dextra inferior. *a.p.d.*^{1}, *a.p.d.*^{2}, Mesial and lateral branches of the arteria phrenica dextra inferior. *a.p.s.*^{1}, *a.p.s.*^{2}, Large branches of the arteria phrenica sinistra inferior.

phrenic veins become filled with emulsion when the vena portæ is being injected. Similar anastomoses exist throughout the entire bare area on the posterosuperior surface of the right lobe. As in the case of the arteria hepatica, the injection of one or the other of the main branches of the vena portæ leads to complete injection of the entire venous tree. The path of collateral circulation between the right and left divisions of the vena portæ was demonstrated by an experiment similar to that performed in determining the course of compensatory circulation between the rami dexter and sinister of the arteria hepatica propria. The emulsion was injected through the left division of the vena portæ during about half the time required completely to inject the entire venous tree. The stereoscopic pictures of this injection showed the entire system of veins in the left lobe, quadrate lobe, gall bladder, and left half of caudate lobe completely filled, while several large portal branches in the right lobe near the gall bladder were partially filled. The main right division con-

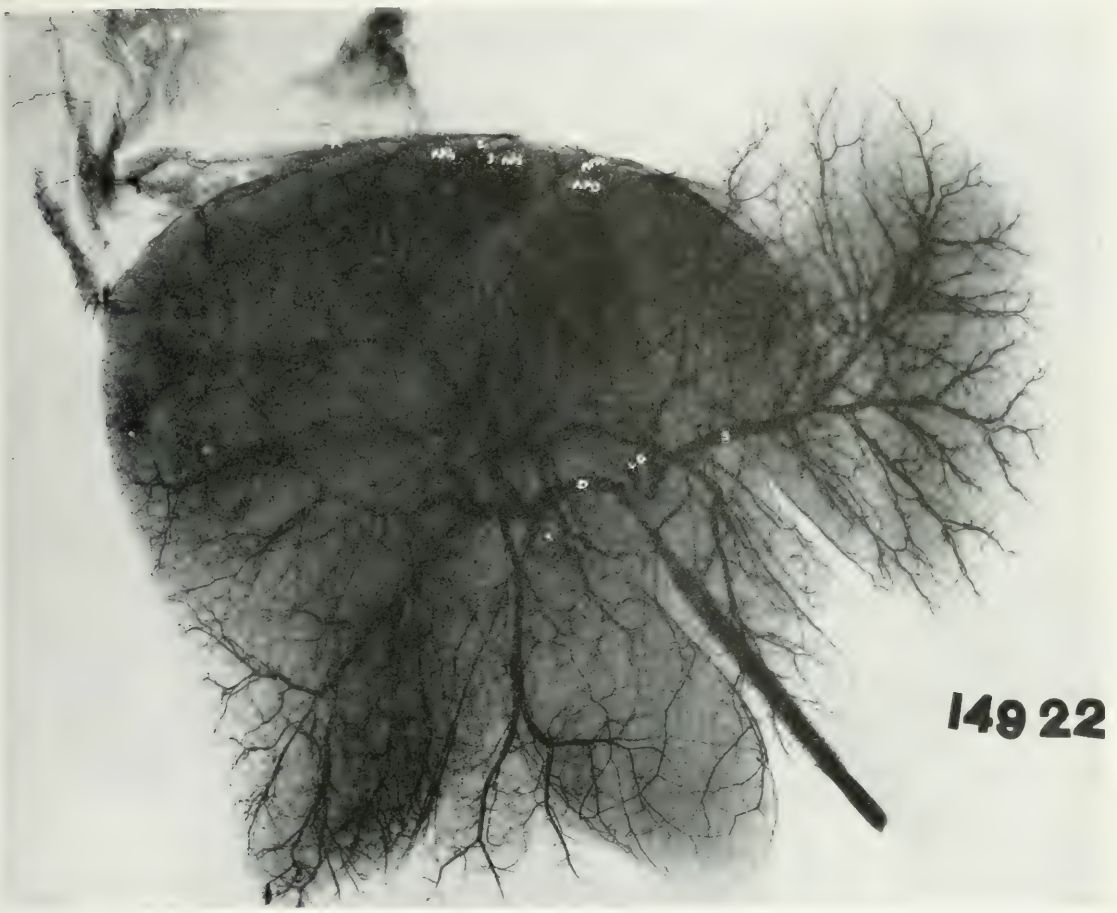

Fig. 8. Injection through the ramus dexter alone, with arteria cystica ligated. Third decade. (A-149-22. Female, age 34, died of peritonitis.) The ramus sinister arteriæ hepaticæ propriæ, its branches to the lobus quadratus and the arteria cystica just beyond its origin from the ramus dexter were ligated separately. The ramus sinister was severed near its point of origin. The cannula was inserted into the ramus dexter and tied beyond the point of bifurcation of the propria, so that the injection mass was forced in only through the ramus dexter. Note the complete injection of all branches of both rami including the arteria cystica. This picture shows that the intrahepatic arteries in the third decade of life are as yet quite straight. *a.p.d.*, A short stump of the main stem of the arteria phrenica dextra inferior and portions of two of its branches *a.p.d.*[1], *a.p.d.*[2], *a.p.s.*, The main stem of the arteria phrenica sinistra inferior and its three branches, *a.p.s.*[1], *a.p.s.*[2], *a.p.s.*[3]. *Dia.*, A portion of the diaphragm showing the abundant anastomoses among its arteries and arterioles. *a.*, *a.*, *a.*, Anastomoses between arteries and arterioles of phrenic and hepatic origins. Note the important anastomoses in the region of the gall bladder and porta hepatis, *p.h.*, as well as those in the fossa umbilicalis, *f.u.*; *d*, ramus dexter; *c.*, arteria cystica; *s.*, ramus sinister; and *l.q.*, branch of ramus sinister to lobus quadratus.

tained a small amount of emulsion. The collaterals are therefore in the hilus and in the gall bladder where branches of the left main division of the vena portæ coming from the lobus quadratus anastomose with those of the right coming from the vena cystica and the vessels of the right lobe of the liver around the gall bladder. There are no subcapsular anastomoses to assist in the collateral circulation between the different branches of the vena portæ. For a fluid with a viscosity such as that of blood, the collaterals are, however, not limited to the anastomotic courses just described for the capsular capillaries, and the peripheral capillaries around the lobules anastomose freely with each other and with those of neighboring lobules, so that a wide range of extrahepatic and intrahepatic col-

Fig. 9. Injection through ramus sinister alone, sixth decade. (A-63-22. Male, age 65, encephalomyelitis.) The ramus dexter arteriæ hepaticæ propriæ was ligated just beyond its origin from the point of bifurcation of the propria. The cannula was inserted into the ramus sinister and tied beyond the origin of the artery from the propria, so that the barium sulphate-gelatine emulsion was injected only through the ramus sinister. Note the complete injection of all branches of both rami sinister and dexter as well as some diaphragmatic vessels. In this liver from a man in the sixth decade of life the arteries are everywhere markedly tortuous. Compare with Figure 3, for second decade; Figure 8, for third; Figure 7, for fourth, and Figure 5, for fifth decade. *r.*, Ramus dexter; *s.*, ramus sinister; *g.b.*, gall bladder; *Dia.*, diaphragm.

laterals come into play when the portal circulation of one part of the liver must compensate for that of another. The fact remains, however, that a large majority of the branches of the portal vein do not take part in vein-sized or venule-sized anastomoses.

The collateral circulation of the vena portæ, both as regards draining portal blood into the systemic veins and supplying the liver with it from accessory portal veins in the lesser omentum, has been thoroughly investigated and is described in standard books on the anatomy and physiology of the liver as well as in surgical and pathological treatises dealing with obstruction of vena portæ from thrombosis, pressure, cirrhosis, etc. We consider it worthy of noting here that in 35 per cent of our series of 55 livers the umbilical vein was patent in more than two-thirds of its length and its lumen communicated with that of the left division of the vena portæ in all of these instances. It is a significant fact that the organs and tissues which are supplied with arterial blood by the arteria cœliaca, the arteria mesenterica superior and the arteria mesenterica inferior are drained of their venous blood principally by the portal system of veins and while these arteries are all connected up by a large series of anastomoses which take place between their smaller branches, the smaller tributaries of the portal system also form a continuous series of anastomoses.

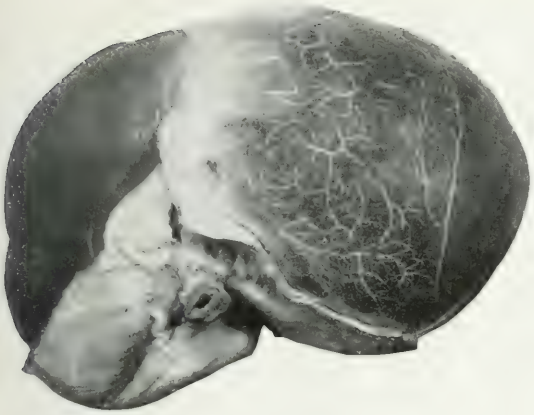

Fig. 10. Short time injection through ramus dexter alone with partial filling of the branches of the ramus sinister. (A-135-22. Infant, 9 months old; died of malnutrition.) The injection was made through the ramus dexter arteriæ hepaticæ propriæ alone, and continued only for 4 minutes, i.e., about half the time required to inject the entire arterial tree. Roentgenogram showed complete injection of all branches of the ramus dexter, but only the larger branches (first, to fifth and sixth orders) of the ramus sinister were filled. Note the complete injection of capsular and subcapsular arteries over right lobe and only very few over left lobe, near its right border. (Some of the vessels are tortuous because of shrinkage of the capsule due to formalin fixation.) The vessels to tissues of the porta hepatis were more completely injected in the right than in the left half. (See "Collateral Circulation between Ramus Dexter and Ramus Sinister.")

Fig. 11. Vena portæ. (A-166-21. Infant, 9 months old; died of malnutrition.) Portal vein injected. Note the wide sinus at the bifurcation of the vena portæ into a short right and a longer left division. The sinus and both divisions before they enter the substance of the liver give off branches to the lobi caudatus and quadratus. The branching is dichotomous, the vessels show no tortuosity, the diminution in size is quite gradual as far as the fifth order of branching, then it becomes more sudden. The gall bladder is collapsed and very small so that its anastomosing system of veins cannot be clearly made out except in a stereoscopic view of this picture. (For Vena Cystica see Fig. 16.) *s.*, Sinus; *r.*, right division; *l.*, left division.

Furthermore, both the vena portæ and the arteria hepatica, which is a branch of the arteria cœliaca, anastomose with phrenic vessels, thus forming a communication between the thoracic and abdominal circulations.

The embryological explanation given above for the latter arterial communications may also be applied to the venous anastomoses in the diaphragm.

THE VENÆ HEPATICÆ

The venæ hepaticæ drain the blood from the liver directly into the vena inferior, entering this vein just before it passes through the diaphragm. The radicals of the hepatic veins converge to form three large groups: a right, draining the right lobe; a middle group, draining the mid-portion of the liver, lobus caudatus and lobus quadratus; and a left group draining the blood from the left lobe. Where the vena cava lies in direct contact with liver surface, it also receives numerous small veins from liver substance. Considering the largest main vein of one of these three groups as a branch of the first order, then seven orders of branching are found injected with barium emulsion, the seventh order being the sublobular veins into which empty the central veins of each lobule. Here and there some central veins are seen to be filled with emulsion forming an eighth order of branching. The fifth to the eighth orders of veins join with each other to form arches with angles of about 80° to 100°, similar to those of the vena portæ. The larger radicals, however, those of the second, third, and fourth orders, converge more acutely toward the main vein forming angles of 20° to 45° at their junctions. The diminution in size of vessels is similar to that of the branches of the vena portæ; as far as the sixth order it is gradual; then it becomes much more sudden and pronounced.

In the four livers injected through the venæ hepaticæ, the gall bladder presents only very few small venules containing emulsion (Fig. 12). This appears to be a conclusive proof of the fact that the vena cystica and the other smaller branches of the vena portæ, described

Fig. 12. Venæ hepaticæ. The cannula is in the vena cava inferior near the point of its entrance into the right auricle. The portion of the inferior vena cava that is intimately attached to the inferior surface of the liver is filled with emulsion; this, together with the close approximation of the hepatic veins to each other as they enter the vena cava inferior accounts for the dense shadow with little or no detail in the upper half of the mid-portion of the liver in this photograph. The three groups of veins, the left, middle, and right, are, however, apparent. Note the angles formed by the union of the seventh, sixth, and fifth orders (60° to 90°) and the more acute angles formed by the junction of the larger veins (20° to 60°). The shadow of the moderately distended gall bladder is evident; note the very few small veins injected. *d.*, Right group; *m.*, middle group; *s.*, left group; *g.b.*, gall bladder; *v.c.i.*, vena cava inferior; *p.*, *p.*, phrenic veins.

above, as entering the gall bladder, drain by far the greater part of the venous blood of the gall bladder.

THE BILE CHANNELS

The excretory ducts of the liver begin as little canals (ductus interlobulares) which unite to form larger and larger channels and ultimately end in two or more chief branches which emerge from liver substance into the porta hepatis. The two largest of these latter channels come from the right and left lobes (rami dexter and sinister hepaticus) and are joined by several smaller ducts from the lobus caudatus and lobus quadratus. When the union of these ducts, to form the ductus hepaticus, takes place in the vicinity of the right third of the porta hepatis, then the left main duct receives most or all of the smaller ones before it joins with the right duct. The converse of this is also true but occurs less frequently. Occasionally the union takes

Fig 13. Ductus hepaticus. (A-81-22. Male, aged 7; died of diphtheria.) The gall bladder was collapsed and empty. On squeezing the liver, no bile flowed from the ductus choledochus. The cannula, *g.c.*, was inserted into the ductus hepaticus, *d.h.*, proximal to its junction with the ductus cysticus. *d.*, Ramus dexter ductus hepaticus; *s.*, ramus sinister ductus hepaticus; *l.q.*, tributary from lobus quadratus emptying into ramus sinister; *l.c.*, a large tributary from lobus caudatus emptying into ramus dexter near its point of union with the ramus sinister to form the ductus hepaticus.

place opposite the middle third of the porta hepatis, and then the left duct receives all of the smaller channels from the lobus quadratus and some of those from the lobus caudatus, while the point of union and the right duct receive the remaining small ducts.

The bile duct systems of six livers were injected by the method described above. Considering the rami dexter and sinister ductus hepaticus as branches of the first order, seven orders of branching were filled with emulsion. The general characters of the branching are similar to those of the arteria hepatica and vena portæ. The two branches of the second order on each side appear to be an anterior (usually the larger) and a posterior rather than an inferior and superior as is the case with the corresponding branches of vein and artery. The anterior was the largest in five cases on the right side, and in a similar number of cases on the left side, while the two branches were of about equal size in one case on the right and in another case on the left side. In all instances the channels of the caudate as well as those of the quadrate lobe unite before joining with the main left or right branch. In two instances a separate larger vessel begins in the quadrate lobe, drains liver substance around the gall bladder and ends in the right main duct.

INFARCTION OF THE LIVER

In the absence of any accessory hepatic arteries or of unusually large arterial collaterals, more or less sudden total obliteration of the flow in a normal arteria hepatica propria will be followed by necrosis of the liver. This fact, so far ascertained only experimentally on rabbits, dogs, and cats, strongly emphasizes what has already been stated above, namely,

Fig. 14. Arteria hepatica in a case of metastases of carcinoma in the liver. (A-8-22. Male, age 42; carcinoma of lung.) The uniformly black areas represent nodules completely surrounded by extravasated emulsion. The small nodules show the anastomosing arteries about their periphery and penetration of arteries toward centers.

that arterial oxygenated blood is essential to the health and very life of liver substance. Because of the abundant collaterals between the rami dexter and sinister (see "Collateral Circulation between Ramus Dexter and Ramus Sinister"), obstruction of either of these arteries leaves the liver in its normal condition. Obliteration of the arterial flow in the branches of either ramus sometimes is and sometimes is not followed by infarction of the part supplied by the obstructed vessel. The explanation for these phenomena is to be found in the nature of the distribution of anastomoses and in the path followed by collateral circulation between various branches of the two rami. As was pointed out above, the blood follows the course of least resistance from the patent large vessels into the nearest anastomoses between it and the obstructed vessel, thence into the latter vessel and finally into all the ramifications of the obstructed branch. Those intrahepatic branches of the two rami which have subcapsular ramifications necessarily have collaterals through the surface anastomoses and when one of these vessels is obstructed, liver substance supplied by it does not suffer any change. On the other hand, the arterial branches which end within liver substance and do not take any part in the subcapsular communications have only an extremely

limited course of collateral circulation from the anastomosing small vessels in the portal sheath and around the portal vein, bile ducts, and nerves. Only when a very small artery is blocked at a point between the origins of some of these small vessels can the anastomoses between the small arterioles arising proximal and distal to the point of obstruction be expected to function as efficient collaterals. If the lumen of a larger artery without subcapsular collaterals is obliterated, then there must follow infarction of the intrahepatic area supplied by this vessel. Hence the great frequency with which infarcts of liver do not involve the surface and are discovered only on sectioning the organ. These infarcts are at first hæmorrhagic from stagnation of portal and venous blood, but the liver substance undergoes necrosis and portal vessels become obliterated by thrombi, the infarct becomes white both from anæmia and from the color of necrosing and autolysing tissues. If the individual lives long enough after the occurrence of the obstruction, the infarct heals by granulation tissue formation (Kaufmann).

THE HEPATIC ARTERY IN A CASE OF PERI-INSULAR CIRRHOSIS

Only one case of peri-insular cirrhosis came to our attention during the course of this study. The hepatic artery was injected in the usual manner. The stereoscopic picture revealed extremely tortuous intrahepatic arteries, some of the vessels actually resembling corkscrews which taper at their distal ends. The subcapsular arteries and arterioles were particularly abundant and they anastomosed with each other very freely.

It is interesting to note that the process by which the liver becomes altered in its general architecture in cases of cirrhosis is analogous to that by which it is altered in the fetus from a simple tubular gland in which the secreting cells are arranged around the excretory bile ducts to one made up of lobules surrounded by fibrous tissue containing nutrient and functional vessels and ducts and with the lobular cells arranged around the central collecting veins. In both cases it is essentially a growth of mesodermal fibrous connective tissue which produces the altered framework

Fig. 15. Arteria hepatica in a case of metastases of carcinoma of the lung, in the liver. From same case as shown in Figure 14. Photograph of the cut surface after injection. Note the mantles of extravasated emulsion around the cancer nodules in the tissues which had undergone pressure necrosis. The cancer metastases contain injected arteries arranged in more or less radiate fashion.

and consequently the altered arrangements of liver substance. The changes in the course of the development of the human liver can be understood both on a basis of the *a priori* consideration that they consist of phylogenetic gradations proceeding ontogenetically and from the *a posteriori* knowledge that the liver is essentially a gland of internal secretion with the hepatic vein as its main excretory duct. This diminution in the importance and significance of the external secretion in the liver simulates the changes in other glands of internal secretion which lead to total obliteration of the external excretory system, as e.g., in the thyroid, which normally retains only a vestige of its thyroglossal ducts in the form of a thin, fibrous cord.

THE DISTRIBUTION OF BLOOD AND BILE CHANNELS IN CASES OF METASTASES OF NEW-GROWTHS IN "THE LIVER"

Two livers which were the seat of numerous cancer metastases and one of metastases of hypernephroma, are included in the 55 livers studied. In one, the hepatic artery was injected; in the second, the portal vein; and in the third, the bile-duct system.

The stereoscopic pictures of the hepatic artery and portal vein injections present numerous large areas which are uniformly opaque to the X-rays (Figs. 14, 15, and 16).

Fig. 16. Vena portæ. Liver contains metastases of carcinoma. (A-37-22. Female, age 41, general carcinomatosis from primary carcinoma of the breast.) Vena portæ injected. The metastases of carcinoma in the liver are surrounded by mantles of barium sulphate-gelatine emulsion, which become extravasated about the nodules in the tissues which underwent pressure necrosis. In the stereoscopic view no branches of the vena portæ were seen to be distributed within metastases. The veins of the gall bladder, *g.b.*, are very well seen in this picture. Note the intimate anastomoses among the veins in the bladder wall and the presence of large veins in its vicinity coming from both right and left divisions which contribute veins that take part in the anastomoses that are evident. Thus these anastomoses contribute to the collateral circulation between the right and left divisions of the vena portæ.

These are due to the extravasation of barium sulphate emulsion in the softened necrotic tissues around the larger cancer masses. In the hepatic artery preparation, the smaller cancer nodules show to best advantage the nature of the distribution of arterial vessels to the tumors. Larger branches are arranged around the nodule and these give off smaller ones which course in the substance of the metastases and are arranged in radiate fashion. The arteries around the periphery of the nodule anastomose with each other here and there, while those within it also present a number of anastomoses. In the case of cancer which we observed, the portal vein does not send any vessels into the interior of the cancer nodules. The larger nodules are surrounded by mantles of extravasated emulsion but show no filled vessels within their substance. The smaller nodules show no trace of barium around them. The liver with metastases of hypernephroma was injected through the bile ducts. No ducts were found in the tumor masses. Some of the branches were somewhat distorted in their course by pressure from the nodules.

It is, of course, impossible to draw conclusive deductions from such a small number of cases, but these results are very suggestive of the fact that portal blood takes no part in

the nutrition of tumor metastases and that bile ducts are either entirely replaced or pushed aside by metastases of new-growth within the liver, while arterial blood alone is responsible for the nutrition of the metastases.

THE COMPENSATORY ARTERIAL CIRCULATION OF THE LIVER IN RELATION TO SURGICAL LIGATURE OF THE HEPATIC ARTERY

Cohnheim and Litten, in 1876, ligated all the arterial branches going to the liver, in the ligamentum hepato-duodenale of rabbits and found that necrosis followed, involving the whole liver. When only a single branch was tied, the lobe which it supplied became necrotic, while the remainder of the liver was not affected in any way. These observations have since been repeatedly corroborated. Haberer, in 1905, and more recently in May, 1922, Behrend and his associates found the same phenomena in guinea pigs as well as in rabbits. Haberer also showed that whereas in rabbits and guinea pigs ligation of a branch of the hepatic artery produces infarction, in dogs and cats the liver substance suffers no change. Litten, in 1890, observed animals as long as three days after tying the hepatic artery and expressed the opinion that the liver could better afford to do without the blood of the portal vein than without that of the hepatic artery. The surgeon Haberer, in his excellent work on experimental ligation of the hepatic artery, found that in dogs, the hepatic circulation of which simulates very closely that of the human liver, tying off the arteria hepatica propria resulted in necrotic changes in the liver which were usually followed by death within 72 hours. In those dogs which survived for a longer period of time and in those that appeared to be unaffected by the operation, he was unable to demonstrate by postmortem examination that the livers of the former series showed only small, scattered, necrotic foci, whereas those of the latter series showed no regressive changes whatsoever. In both these types of cases he demonstrated by means of injection that there existed collaterals from phrenic arteries which he traced in the coronary ligaments as far as Glisson's capsule whereas he found few or no such collaterals in those animals which died within

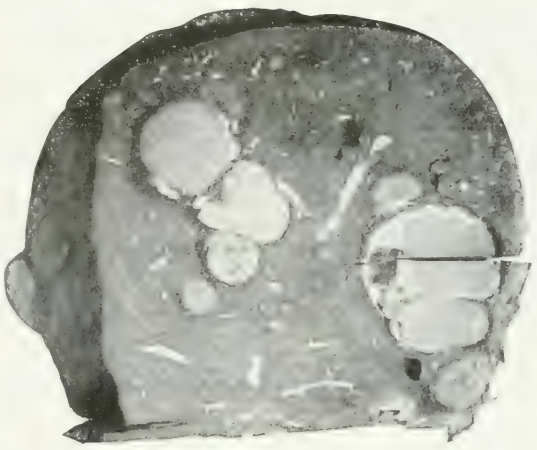

Fig. 17. Vena portæ. (Same case as shown in Figure 16.) A photograph of the cut surface of the same liver represented in Figure 16, showing the mantles of extravasated emulsion around the periphery of the cancer nodules, and the absence of any injected vessels within the cancer masses. The smaller nodules with no mantles of emulsion around them show isolated injected branches of the portal vein in the liver substance adjacent to them. Two nodules near the center and in the right half of the photograph were cut so as to show the mantle of emulsion which surrounded them.

72 hours. These experimental results seem to indicate very clearly that arterial oxygenated blood is essential to the nutrition of hepatic cells.

In the course of abdominal operations surgeons may occasionally meet with conditions of the hepatic artery such as aneurism, trauma, etc., which may call for ligation of this vessel. A considerable number of the 56 reported cases of aneurism of the hepatic artery simulated cases of obstructive jaundice from cholelithiasis, and the true cause of obstruction was discovered only after laparotomy or at autopsy (Rolland; Friedenwald and Tannenbaum).

Such a case was reported by Kaeding in 1919, in which Professor Sudick ligated the artery and the patient recovered. This is the second reported case of recovery following treatment for aneurism of the hepatic artery by ligature. The first was that of Kehr, in 1905.

Holst, in 1921, reported a case in which the hepatic artery was cut during a difficult resection of the stomach. The artery was ligated, the man recovered from the operation which lasted four and a half hours and

appeared to be convalescing favorably, when he suddenly began to grow weak and died eight and a half days after the operation. Holst ascribes the death to necrosis found in the left lobe and accounts for the fact that the right lobe was well preserved by the presence of a small artery in the ligamentum teres. The exact distribution and extent of the necrosis are not described so that it is difficult to discuss this case in the light of our own observations. More recently, Smith, in April, 1921, and Hoffmeister, in February, 1922, reported two cases in which the hepatic artery was cut accidentally during surgical procedures in the epigastric region; in both cases the artery was ligated and the patients made uneventful recoveries. Smith's patient, a woman aged 57, was in good health six months after the operation but was treated medically for acute infection of the gall bladder a month later and again recovered. Hoffmeister's patient was able to get out of bed for a drink 48 hours after the operation and on the sixteenth day showed no signs or symptoms of injury to the liver.

In the case of aneurism of the hepatic artery reported by Tuffier, death took place 3 days after ligation of the artery but no necrosis was found in the liver.

Ledieu in 1856 reported a case of aneurism of the hepatic artery which was completely blocked by a thrombus. The description does not allow one to form a clear conception of the exact position of the aneurism with reference to the arteria gastrica and arteria gastroduodenalis. It was an accidental finding at autopsy, and the liver was not altered as a result of the completely obstructed hepatic artery. In Merkel's case, a dissecting aneurism involved a portion of the arteria hepatica communis including the origins of the arteria gastrica dextra, the arteria gastroduodenalis and the arteria hepatica propria. The aneurism contained a large, firm, canalized thrombus which partially blocked the communis. There was, however, free communication between the latter three arteries through channels in the thrombus, so that the arterial circulation of the liver was maintained largely by collaterals from branches of the mesenteric arteries anastomosing with branches of the arteria gastrica dextra and arteria gastroduodenalis, as well as by the diaphragmatic collaterals. This aneurism also was an accidental finding at autopsy, and the liver did not show any lesions referable to the blocking of the hepatic artery.

The possible necessity of ligating the hepatic artery raises the question as to what are the collateral vessels that will afford a compensatory arterial circulation to the liver and to what extent can they be depended upon to maintain the liver in a healthy state. In this connection, we, first, quote the following significant passages from Haberer's thorough review of the important literature on this subject up to 1905: "On the basis of more theoretical considerations and supported by definite anatomical knowledge about the question, Langenbuch, whose opinion upon the surgery of the biliary tract is highly valuable, expressed the opinion that with the development of collateral branches to a suitable degree, tying of the hepatic artery without much damage being done must be possible. Besides the well-known communications between the branches of the arteria cœliaca and between them and the arteria mesenterica superior, he draws attention to the 'stepmother like treated' (*Stiefmuetterlichbehandelten*) phrenic arteries from which branches are normally given off to the liver."

Langenbuch's statement with regard to the more or less neglected collaterals from the phrenic arteries is corroborated both by Haberer's experimental results and by the evidence obtained from our series of 37 human livers injected through the hepatic artery. As was mentioned above, the phrenic arteries during injection of the hepatic artery, became filled with emulsion through their anastomoses with the surface branches of the hepatic artery, in every instance of our series, which includes injections through ramus dexter and ramus sinister alone as well as through arteria hepatica propria. Haberer attributes the absence of areas of necrosis in the livers of some animals in which the arteria hepatica propria was tied, to compensatory circulation through collaterals from phrenic arteries which he demonstrated by injections. Behrend and his associates ligated the hepatic artery in dogs and cats

and found that these animals "continue to live indefinitely in spite of a combination of peripheral and central ligation." On co-ordinating the results of the following four of their experiments the rôle played by the diaphragmatic arteries in the collateral arterial circulation of the liver becomes clearly apparent:

1. A cat in which the hepatic artery was ligatured centrally (near its origin) was killed 19 days after the operation. The liver cells generally showed hydropic degeneration but were best preserved in the subcapsular areas.

2. Another cat similarly prepared was killed 113 days after the operation. Sections of the liver showed practically no pathological lesions whatever.

3. After ligating both the hepatic artery, centrally, and also the diaphragmatic arteries, the animal recovered and was killed on the sixty-third day after the operation. Sections of the liver showed "irregular focal necroses around the central parts of the lobules and hydropic degeneration in their periphery. The blood vessels were somewhat dilated. It is quite probable that if the animal had been allowed to live long enough the collaterals from the right gastric and gastroduodenal arteries would have developed sufficiently to fulfil all the normal needs of the liver. Moreover, the diaphragmatic anastomosis would in time also take part in the collateral circulation to the liver because of the anastomoses between branches of the phrenic arteries with other branches of the thoracic aorta.

The only animal of the entire series which succumbed to the operation was one in which the hepatic and diaphragmatic arteries were ligated. The cat died 48 hours after the ligation and its liver showed "universal necrosis."

Thus, from anatomical evidence obtained from the study of human livers and from the experimental results of Haberer and Behrend, *et al.*, it is deduced that the anastomoses between the branches of diaphragmatic arteries and those of the hepatic artery (in the regions described in a previous chapter of this communication), play an essential rôle in the collateral arterial circulation of the liver.

The well-known anastomoses which Langenbuch refers to as existing between the branches of the arteria cœliaca and between them and those of arteria mesenterica superior are fully described in standard books of anatomy. In general, it is permissible to state that there exists a continuous chain of anastomoses between all the branches of the arteria cœliaca and that some of the links in this chain anastomose with certain branches of the arteria mesenterica superior.

Haberer investigated the relative importance of various groups of these anastomoses with reference to the ligation of the hepatic artery experimentally on dogs and cats and came to the following conclusions:

"1. The arteria hepatica communis in its main stem may be ligated without fear for the nutrition of the liver."

(This conclusion is very well supported by Merkel's case of an aneurism of the arteria hepatica communis which was almost completely blocked by thrombus formation. The arterial circulation of the liver in this case was maintained mainly by collaterals from the right gastric and the gastroduodenal, and also from the diaphragmatic arteries.)

"2. Ligation of the arteria hepatica propria before it gives off the arteria gastrica dextra usually should not hurt the nutrition of the liver.

"3. Ligation of the propria distal to the origin of the arteria gastrica dextra when the hepatic artery is previously healthy results in more or less extensive necrotic changes and eventually total necrosis is a probable outcome that must be feared. But if the artery is diseased then it is permissible to ligate at this point with freedom from fear of untoward results, because one can count upon a previously developed collateral circulation.

From these conclusions it appears that, in tracing the effect of ligation at various points along the course of the hepatic artery commencing at the arteria cœliaca, the nearer the point of ligation is to the bifurcation of the propria the greater will be the danger of necrosis. Furthermore, the danger of necrosis in human livers diminishes in ligation of single branches distal to the bifurcation with the exception of those branches which end within the liver and therefore do not participate in the subcapsular anastomoses.

It is logical to assume that a gradually increasing partial obstruction to the arterial flow in a given artery will cause its collateral circulation to become correspondingly more and more developed, until this is capable of replacing the previously normal source of arterial blood to the part. Such a compensatory circulation may result from an aneurism, especially from a healing aneurism, or from pressure upon the artery from a neighboring tumor. The late Professor Halsted, of The Johns Hopkins University, produced the same effect by applying a partial ligature made of aluminum or of tape. These principles apply to the arteria hepatica propria and its collaterals including those from the diaphragmatic arteries. Therefore, it seems reasonable that when the necessity for ligating this artery is not an urgent one requiring immediate complete tying off and if the obstruction has only recently begun, or if the artery is still quite normal, conditions favorable for the widening of the existing collaterals may be produced by applying a partial ligature. However, if the natural cause of obstruction is one of long standing, such as a moderately large, partially healed aneurism which has caused an apparent widening and thickening of the artery proximal to it, it is safe to assume that the collaterals have already sufficiently developed and the propria or both its main branches, the ramus dexter and ramus sinister, may be ligated.

Kaeding refers to Baruck, Trunert, and Bode who suggest that in order to increase the number of collaterals, a preliminary operation consisting of the production of adhesions about the liver and compression of the aneurism should be performed before ligating the hepatic artery. In the opinion of Kaeding, this preliminary operation is not always necessary when the hepatic artery is the seat of an aneurism.

When the necessity arises for ligating a previously normal hepatic artery without delay as, for example, because of traumatic rupture or purulent necrotic changes of the arterial wall, then the surgeon must be encouraged by the frequent occurrence of anomalies which enhance the collateral arterial circulation of the liver. Haberer reports the presence of an arteria hepatica accessoria in 33 per cent of 75 cases in dogs; in these instances it arose most frequently from the arteria mesenterica superior, but also from the arteria gastrica sinistra and the spermatic or renal arteries. We found one or more arteriæ hepaticæ accessoriæ in 11 instances. In one of these cases in which the accessory artery sprang from the arteria gastrica sinistra, injection through the ramus dexter led to complete injection of all arteries of the liver, stomach, and duodenum, partial injection of the arteries of ileum, pancreas, spleen, and adrenals. If the injection had been made through the arteria gastrica sinistra in this case, no doubt the same result would have been obtained. Quite frequently an atypical origin and course of the arteria hepatica communis may favor and increase the efficiency of the normal collateral circulation. Thus when the rami dexter and sinister arise separately from the abdominal aorta, or from the arteria cœliaca and arteria mesenterica superior or even when the arteria hepatica communis is present and bifurcates very soon after its origin, the ramus dexter courses in the ligamentum gastrohepaticum alone, and if necessary it can be tied at any time in any part of its course and under any conditions of its walls without fear of causing regressive changes in the right lobe. Occasionally the arteria gastroduodenalis and the arteria gastrica dextra arise at or very near the bifurcation of the propria or directly from its rami. In such cases it is not at all dangerous to tie the hepatic artery at any point between the origin of the communis and the region of the bifurcation. The fact that no given artery distributes itself in exactly the same manner in any two or more cases, first enunciated by Frederick Ruysch, is now well established. The frequency with which anomalies of the hepatic artery occur which may enhance the collateral circulation of the liver must be most encouraging to the surgeon who is confronted with the task of ligating this vessel.

SUMMARY

The injection technique of Gross as applied to injecting the blood and bile channels of the liver is described.

The average normal and some anomalous types of extrahepatic branching of the arteria hepatica are described from the study of 55 livers.

The intrahepatic branches of the hepatic artery are quite straight in the earlier decades of life (up to fourth or fifth), but become more and more tortuous with advancing age.

The distribution of the intrahepatic branches of the rami dexter and sinister, arteria hepatica propria and of the arteria cystica is fully described from the study of 37 preparations.

The subcapsular arterial anastomoses and those in the tissues of the porta hepatis constitute the courses of the collateral circulation between the rami dexter and sinister.

Some intrahepatic arteries are end-arteries.

The course of collateral circulation between a patent and an obstructed branch of the hepatic artery is from the collateral vessels into their larger parent vessels (branches of the blocked artery), thence into the main branch as far as the point of obstruction and finally from this into all the ramifications of the blocked artery. This principle also applies to the collateral circulation between the right and left branches of the vena portæ.

The anastomoses which form the path of collateral circulation between diaphragmatic and hepatic arteries are described.

The intrahepatic branches of the vena portæ differ from those of the hepatic artery in their greater caliber and in the more sudden diminution in size from the fifth to the sixth and seventh orders of branching. There are no subcapsular anastomoses between the venule-sized branches of the portal vein. The anastomoses which are responsible for collateral circulation between the right and left branches of the vena portæ are as follows: venules in the tissues of porta hepatis, the perilobular and the subcapsular capillary anastomoses.

Those branches of the vena portæ which terminate within the liver do not take part in vein-sized or venule-sized anastomoses. Among those which terminate on the surface some form vein-sized or venule-sized anastomoses with other branches of the portal vein or with systemic veins (diaphragmatic, peritoneal, etc.), while others end similarly to those which terminate within the liver.

The venæ hepaticæ converge to form three groups: a right, a middle, and a left group. The angles formed by the junctions of the larger vessels are much more acute (15° to 40°) than those formed by the branching of the vena portæ (60° to 90°). The central group receives a few very small radicals from the gall bladder, the venous blood of which is drained mainly by tributaries of the vena portæ, principally the vena cystica.

The intrahepatic and extrahepatic courses of the bile ducts are described from a study of six preparations.

Arterial blood is absolutely essential to the nutrition of liver substance. Complete obstruction of either the ramus dexter or ramus sinister, arteriæ hepaticæ propriæ, does not effect any change in the liver substance normally supplied by the blocked vessel. The abundant anastomoses which afford the efficient collateral circulation in such cases are described.

Infarcts of the liver follow obliteration of those arteries which terminate in the liver without sending any branches to the subcapsular system of anastomoses, and which are therefore proper end-arteries.

In peri-insular cirrhosis, the intrahepatic arteries appear extremely tortuous, and the subcapsular anastomoses are particularly abundant.

In one case of metastases of new-growth in the liver, the hepatic artery gave branches to the tumor masses. In another case the portal vein was injected, but the tumor masses did not receive any branches from it, while in a third instance the injection of the bile ducts showed no evidence of ducts within the metastases.

The conclusions of Haberer with regard to surgical ligation of the hepatic artery are also true for man because of the close resemblance between the arterial circulation of the human liver and that of the dog and cat with which he experimented.

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I wish to express my sincere thanks to Misses Hannah and Jackson and to the other members of the Royal Victoria Hospital X-ray Department for their very generous co-operation.

SEGMENTAL RESECTION OF THE BLADDER FOR NEOPLASM[1]

By J. BENTLEY SQUIER, M.D., F.A.C.S., New York

SEVEN years ago, in a paper read before the American Urological Association entitled "Radium Versus Surgery in the Treatment of Vesical Neoplasm," I concluded as follows:

"Therefore, in the light of our present knowledge, we believe that cures in bladder tumors by the use of radium may be hoped for only in benign papillomata; that it may be possible in certain instances to render the symptoms of vesical malignancy less distressing by intra-urethral, suprapubic, rectal, or cross-fire intra-urethral and rectal radiations; that by the time vesical carcinoma has been made clinically manifest the growth has extended too far to be readily influenced by the amounts of radium at present at our command; that the question of the best management of a case of vesical carcinoma is no different than the management of carcinoma anywhere else in the body—and such is, if the growth is anatomically accessible, wide surgical extirpation followed by every means known to science to treat any unremoved growth or recurrence.

"We may find, however, as further experience develops more ingenious means to use radium intravesically, that radiating the tumor before operation may lessen the danger of tumor transplants occurring at time of operation."

Summing up the experience of myself and others since then, it seems that we are even now only in an experimental stage in the use of radium diathermy, or high voltage X-ray, and that surgery must still be regarded as the method first in importance of therapeutic choice in the treatment of early vesical cancer.

Nevertheless, surgical treatment of malignant tumors of the bladder leaves much to be desired, and mainly so because the diagnosis is often masked by lack of symptomatology, until the tumor has grown to such an extent that complete surgical removal is out of the question.

However, accumulating evidence shows that vesical carcinoma is late in metastasizing outside of the bladder and that for a very considerable period may remain localized, this, of course, being the surgically favorable period.

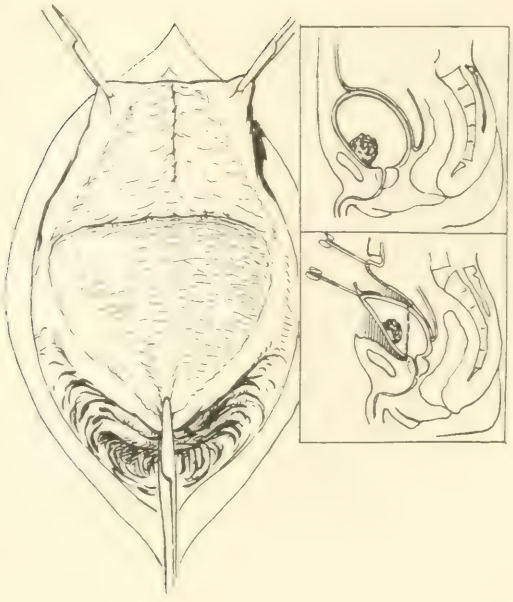
If we reflect that better surgical results in gastric carcinoma did not obtain until the type of operative removal was adapted to the lymphatic supply of the organ, and definite zones of lymphatic extension mapped out, we may fear that success in bladder surgery for tumor removal, if dependent for solution upon a similar problem, may never produce as good results.

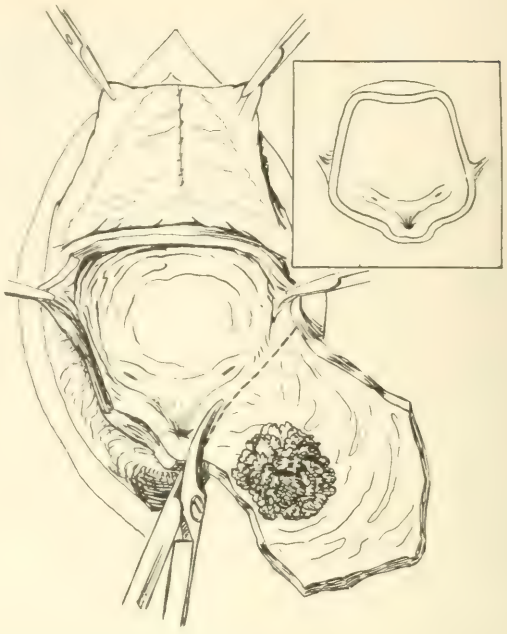
In the stomach, the lymphatics are anatomically separated into three zones: one from the upper two-thirds of the stomach, draining upward to the lesser curvature and the cardia; another, from the lower half of the greater curvature toward the fundus, draining toward the spleen; and a third, from the lower half of the greater curvature, draining toward the pylorus. These systems of lymphatics empty in certain directions. Upon this basis, removal of definite areas of the stomach supplied by a particular zone of lymphatics, as well as the tumor area, must be carried out if permanent cure is to be gained.

The presence of lymphatics in the vesical mucous membrane seems improbable, the supply being an intramuscular one. The emergent vessels of this system terminate in a network on the outer surface of the bladder muscle under the peritoneum or umbilicoprevesical fascia. The course and termination of this network vary according to their situation on the anterior or posterior surface of the bladder.

Anterior surface. From the anterior surface of the bladder there are two groups of connecting trunks. The trunks coming from the inferior segment of the bladder run outward transversely and pass into a gland on the lateral surface of the pelvic cavity, between

[1] Read before the Clinical Congress of American College of Surgeons, Boston, October 23–25, 1922.





Figs. 1 and 2. When the tumor is on the anterior surface, the bladder is bisected laterally and excised down to the internal sphincter.

the external iliac vein and the obturator nerve behind the crural ring. From the superior segment of the anterior surface the trunks run upward and outward, cross the hypogastric artery, and terminate in the middle gland of the middle chain of the external iliac group. Small glands are found along the course of these trunks—called interrupting glandular nodules. Some are in front of the bladder, the prevesical glands; others where the lymphatics cross the hypogastric artery, the laterovesical glands.

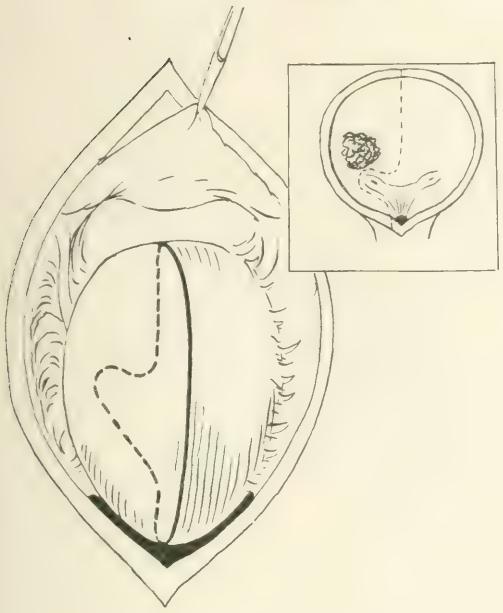
Posterior surface. The posterior surface trunks also form several groups. (a) From the superior portion of the bladder they cross the hypogastric artery and terminate in the external iliac glands with the superior lymphatics of the anterior surface. (b) Other trunks run backward following the hypogastric artery and end in a gland situated on the external iliac vein, in front of the bifurcation of the common iliac artery. (c) Other trunks come from the middle segment of the posterior surface and end in the hypogastric glands. (d) Trunks arising from the inferior posterior surface near the bladder neck, run backward, cross the lateral surfaces of the rectum, ascend on the anterior surface of the sacrum and end in glands situated at the bifurcation of the aorta.

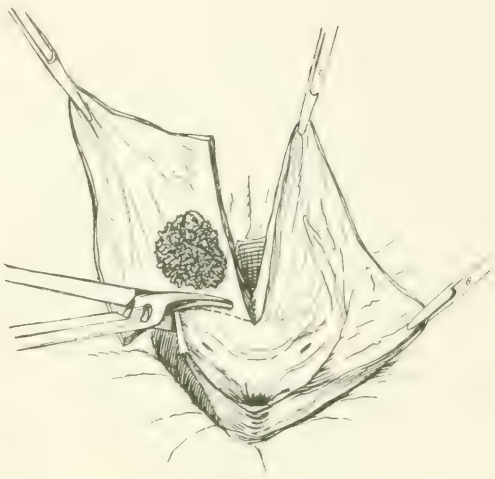
In addition, the prevesical network is continuous with the network which surrounds the prostate, the vesiculæ seminalis, the vasa and the lower end of the ureters. (Poirier-Cuneo-Delamere.)

It would seem that the lymphatic supply is greater in the fundus than in the lower third of the bladder, even taking into account the regression which takes place early in life in the structures of the hypogastric arteries and umbilical cord.

Since the muscular action of the bladder in expelling urine is from above downward, so the drainage of the lymph spaces is toward the inferior bladder segments. Therefore, when operating upon a case of vesical carcinoma, in order to guard against the possibility of lymphatic extension of the disease outside the bladder, the following glandular groups would have to be re-excised:

1. The two middle and external chains of the external iliac group,





Figs. 3, 4 and 5. When the tumor involves the lateral walls, the bisection is made from before backward in the median line and the line of bladder excision made just above the ureteral orifice or as in tumors involving the ureter.

2. The hypogastric glands,
3. The sacral glands,
4. The group of the promontory,
5. The interrupting glands which pass alongside of the bladder fundus, accompany the umbilical artery or come in contact with the vesical neck.

The above extirpation is surgically impossible and thus the conclusion is forced upon us that extirpation of bladder malignancies must be a compromise between the ideal and the possible.

In reviewing a series of 60 cases of vesical carcinoma upon which resections were performed by me or my associates at the Post Graduate Hospital, the locations of the tumors could be grouped into different segments:

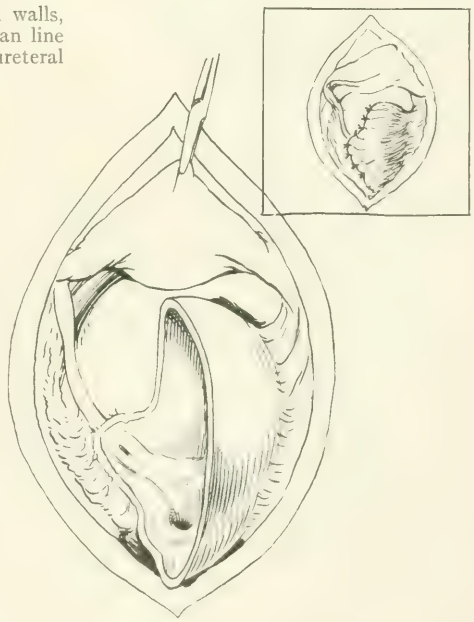
Tumors in the superior fundal segment,

Tumors in the lateral wall segment,

Tumors in the ureteric and post-trigonal segment,

Tumors in the sphincteric segment.

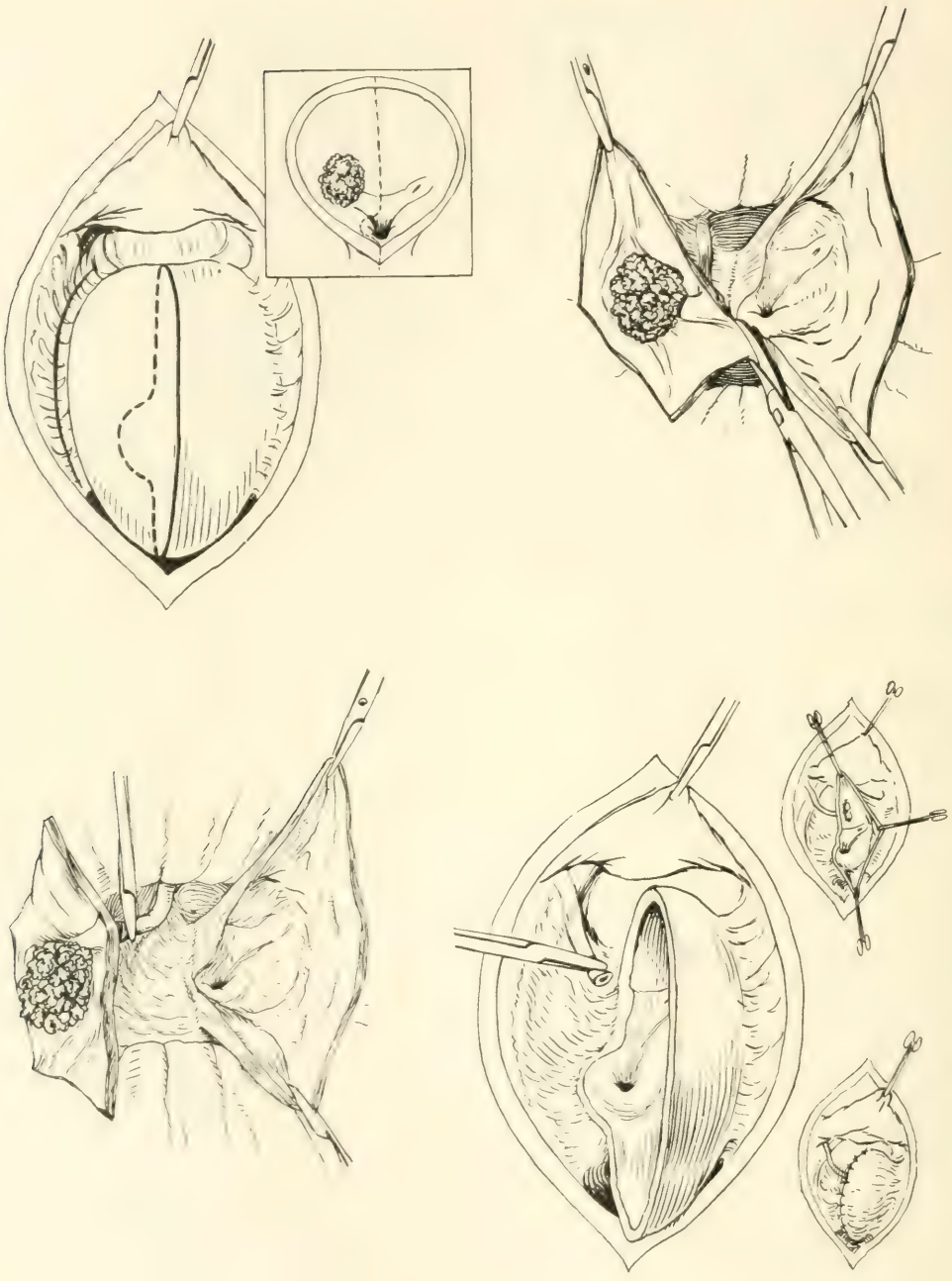
Tumors without the ureteric segment were usually on the fundus or lateral walls of the bladder.



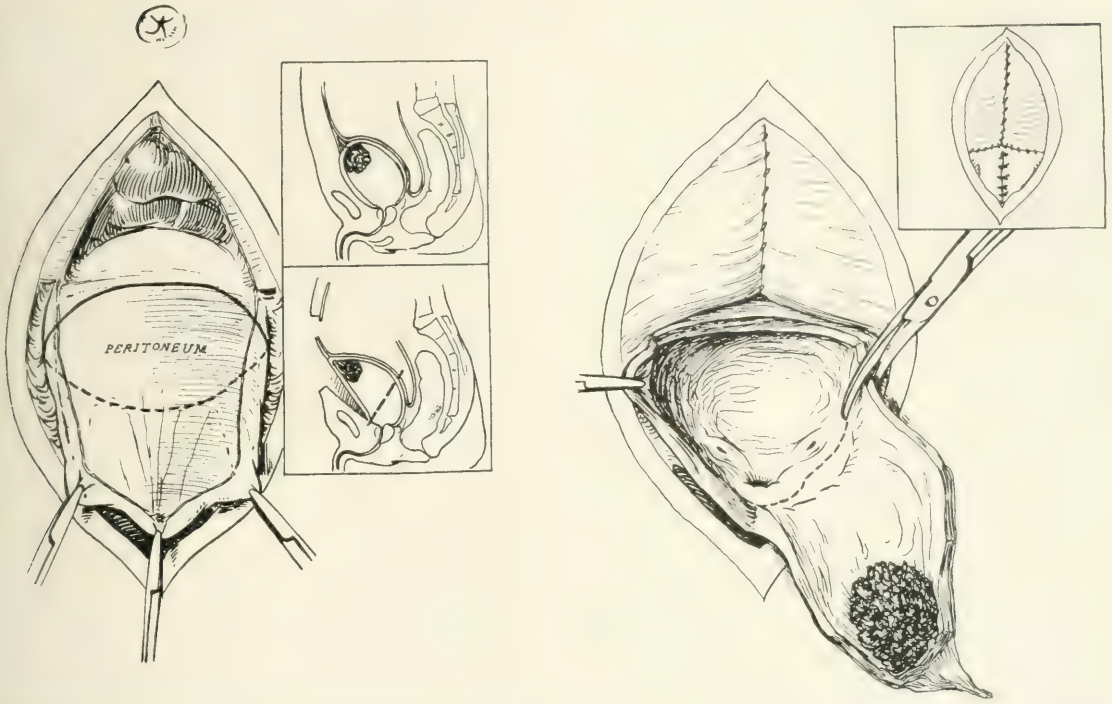
Of the 60 cases referred to, in 9 the tumor was of the fundus on that part of the bladder which had peritoneal covering.

In 31, the tumors occurred in the lateral wall segments without ureteral involvement.

In 20 cases the tumor surrounded the ureteral orifice or involved the trigone near the ureter.



Figs. 6 and 7 (above) and 8 and 9 (below). When the tumor involves the ureteral segment, the bisection is the same but the line of excision is just back of the internal sphincter, with transplantation of the ureter.



Figs. 10 and 11. When the tumor is at the fundus near the insertion of the urachus, it is removed with the urachus and attached adventitious tissue, *en masse*.

Tumors involving the sphincteric segment seem to be secondary to prostatic neoplasm or recurrences of growth primarily located elsewhere in the bladder.

Our experience seems to show that tumors of the superior and lateral wall segments recur more rapidly than tumors of the ureteric segment and that extensive removal of bladder wall toward the base is indicated in tumors in this location. When the growth is in that part of the bladder which is situated just beneath the prevesical space, rapid recurrence is almost an invariable rule. The reason for this is readily understood when one takes into consideration that at this point not only do the lymphatics of the bladder empty into their trunks but are in communication with the network of lymphatics which surround the prostate, vesicles, and vasa.

In several cases when the original tumor occupied the fundus or was high on the lateral walls, recurrences have all taken place in that section of the bladder remaining between the site of tumor and bladder sphincter. Therefore, it is now our custom when operating upon tumors in these locations, to remove bladder wall down to the internal sphincter of the bladder.

When the tumor is on the anterior surface, the bladder is bisected laterally and excised down to the internal sphincter (Figs. 1 and 2).

When the tumor involves the lateral walls, the bisection is made from before backward in the median line and the line of bladder excision made just above the ureteral orifice, or as in tumors involving the ureter (Figs. 3, 4, and 5).

In the growths involving the ureteral segment, the bisection is the same but the line of excision is just back of the internal sphincter, with transplantation of the ureter (Figs. 6, 7, 8, and 9).

Tumors occurring at the fundus near the insertion of the urachus should be removed with urachus and attached adventitious tissue *en masse*, peritoneum, etc., up to the navel (Figs. 10 and 11).

Tumors occurring in that part of the fundus which is covered by peritoneum, should be removed with attached peritoneum.

In this connection it is an interesting observation that early intraperitoneal metastasis is unusual. In only 4 of the 60 cases was this condition present.

Tumors in the ureteric segment should be removed with the ureter end attached and the ureter divided only after the mass has been entirely freed and hangs from the ureter as a pedicle—usually about 2 inches of the ureter with attached fat and fascia must be removed.

The argument for definite segmental resection is based not alone upon the lymphatic supply of the bladder, but because of this tendency for tumors to recur near the internal sphincter. If, for example, the tumor is situated upon the lateral wall of the bladder above the ureteric segment, the course of lymphatic extension would be by way of the trunks draining the superior and inferior segments of the bladder above the trigone. It is my belief, therefore, that all of the bladder wall drained by these systems should be removed with the tumor. This involves an anteroposterior bisection of the bladder with removal of at least one-half of the bladder above the ureteric orifice, and better, the bisection carried to the internal sphincter.

For tumors of the anterior surface of the bladder near the attachment of the urachus, as said before, the bisection is made by lateral incision and the line of excision of bladder is just behind the internal sphincter.

Tumors in this location are prone to recur rapidly, explained probably not only by the more extensive lymphatic supply of the anterior surface of the bladder with the added prevesical plexus of lymphatics, but on account of the greater muscular activity of this part of the organ, cancer cells are squeezed into the lymphatics at an earlier period than in tumors located near the trigone or ureteral orifices.

Be this as it may, it is a clinical observance that those cases in which the original tumor is located upon the anterior aspect of the bladder, although offering the easier operative removal, produce the poorest operative results.

On the other hand, it has been our experience that tumors involving the ureteric segment which necessitate excision of the mural ureter, have given a longer freedom from recurrence and it is among this group of cases that are included our most satisfactory results.

In 1914 I reported an operative technique for the radical extirpation of vesical neoplasms and detailed each step of the operation. Since this, in the main I have followed this technique, but increasing experience has added certain changes which I feel are important.

In this article I advised extirpation of the neoplasms with a wide margin of healthy tissue comprising the entire thickness of bladder wall. Now, as I have already indicated, I believe that the excision should include a segmental resection which in most places will mean a removal of practically one-half of the bladder.

Another change in technique is that, in dealing with tumors which are known to be localized to one lateral wall of the bladder, I do not carry out as extensive a mobilization of the bladder on the opposite side. This seems to have an important bearing upon the reparative period by leaving an undisturbed blood supply of one-half of the organ; lessens the extent of spaces opened up for contamination at time of operation, and minimizes postoperative absorption from these planes.

General statistics are of but relative value, as is illustrated, for example, by the 60 cases referred to in regard to location of tumor site, which were taken from the hospital records from the services of different operators. Many were ward cases and were incompletely followed as to final outcome.

Twenty-seven died during the postoperative period: 24 from shock or uræmia of the progressive cachexia in those in whom it had been impossible to remove the growth; 1 from embolus; 1 from heat stroke, and 1 from suicide.

Twenty-seven were discharged with the comment "improved," at least an operative recovery.

Four were considered cured.

Two were known to return with recurrence.

Some were considered to be operable at the time of cystoscopic examination, only to find at operation that extension existed outside the bladder which could not be outlined by the cystoscope.

Among a series of 75 cases, upon which I have operated by segmental resection and have been able to follow,

Three have lived 8 years without recurrence,
One has lived 7 years without recurrence,
Two have lived 6 years without recurrence,
Four have lived 5 years without recurrence,
Six have lived 4 years without recurrence,
Four have lived 3 years without recurrence,
Eight have lived 2 years without recurrence.

Twenty-seven died in the postoperative hospitalization period, from a variety of causes similar to the other series.

Twenty had recurrences or extensions by metastasis or otherwise, and have died or will do so from this if not other causes.

Twenty-eight are alive after from 2 to 8 years without as yet a recurrence.

STRANGULATED DIAPHRAGMATIC HERNIA OF TRAUMATIC ORIGIN

With Report of a Case [1]

By JERE LAWRENCE CROOK, A.M., M.D., F.A.C.S., Jackson, Tennessee

THE case which furnished the inspiration for this paper consulted us on December 19, 1920, 1 year before the last meeting of this association at which time the operative treatment of the condition was ably presented by a fellow member, Dr. Stone. The subject of "Hernia of the Diaphragm" as suggested by Dr. Stone has received much attention during the last 5 years because of the influence of war wounds in the production of this condition and because of the use of the X-ray in its diagnosis.

In view of the large proportion of cases of traumatic origin, it would not be far-fetched to consider every left-sided gunshot and stab wound of the chest as a potential diaphragmatic hernia. It is easy to understand the mechanics of traumatic hernia of the diaphragm if one considers the features involved in its formation. Of primary importance is the force of aspiration of the thorax which is exerted through the small slit in the diaphragm on the freely movable abdominal viscera. This constant suction due to the negative pressure in the thorax is aided by other factors within the chest. First of all, the omentum enters the opening and prevents union of the edges. This is followed by the formation of adhesions with the thoracic organs, and upon contraction of these adhesions the abdominal organs are dragged upward. In addition, the pleura has a decided tendency to the formation of exudates and the intraperitoneal pressure is increased.

"The stomach and colon are the organs most commonly herniated, the spleen and small intestine being involved less frequently. In many cases the herniated organs are twisted as much as 180 degrees. The severe nutritional disturbances of the colon are easily explained by this incarceration and torsion." These conditions do not prevail on the right side of the chest because of the presence of the compact and plastic liver just beneath the diaphragm which adheres and plugs the rent. Therefore, right-sided diaphragmatic hernia is exceedingly rare.

The case which I shall report presents such unusual features that I shall describe it in detail and follow with a brief review of the recent literature, confining my discussion to "Diaphragmatic Hernia of Traumatic Origin."

J. W. VanC., age 35, residing at Luray, Tennessee, was admitted to the Crook Sanatorium on December 19, 1920, with a history of having suffered 6 days and nights with intestinal obstruction accompanied by persistent vomiting and extreme pain in the left splenic region and also great tenderness over the appendix. The case was described to me over the telephone as "locked bowels" following a case of

[1] Read before the Southern Surgical Association, Memphis, Tennessee, December 13, 1922.

appendicitis. The patient arrived shortly thereafter in a desperate condition. A careful examination of the abdomen showed great distention and tenderness present over the whole area but most marked over the appendiceal region. He stated that his greatest pain had been on the left side underneath the ribs at first but for the past 2 days it had been centered over the appendix and this was the point of greatest tenderness on palpation. He had been treated 2 years previous for an attack of pain and vomiting which was diagnosed as appendicitis. The history of the case and the patient's condition presented features that could not be explained on the theory of appendicitis alone. On account of the history of extreme pain in the left costal region it was decided to give an enema of barium solution in the effort to locate the point of obstruction in the lower bowel. The patient was placed on the X-ray table under the fluoroscope, and with Dr. O. O. Jones, roentgenologist, and Dr. C. F. Webb, my surgical associate, we watched the progress of the barium solution through the rectum and the sigmoid up to the splenic flexure of the colon where it stopped abruptly. We did not wait for further study of the case but prepared the patient for an immediate operation. On account of the tenderness in the right side with a history of appendicitis, together with an evident complete obstruction on the left side, I decided to make a median incision so that I could reach both sides. As soon as the abdomen was opened an enormously distended ascending colon with a distended and highly inflamed appendix appeared. The colon filled the entire field. Before proceeding further the appendix was removed. Then I made a careful examination with my hand, following up the distended colon, and found a slit in the diaphragm through which the entire transverse colon together with the splenic flexure and a large portion of the greater omentum had been sucked up into the chest cavity. We were somewhat prepared to find this condition, as, after the patient was placed on the operating table and just before the incision was made, one of the nurses in raising the patient's shirt exposed an old scar on the left side between the seventh and eighth ribs. This scar was first observed by Dr. Webb who suggested the possible causal relation between this condition and the obstruction. The patient at that time was anæsthetized, and we could not get the history of the scar. With my hand in the abdomen I was able to insert two fingers in the diaphragmatic opening. I attempted to withdraw the incarcerated colon but I found this exceedingly difficult. When I would withdraw a small portion of it, the suction of the chest would draw it back. The enormous distention of the ascending colon completely blocked the field so that it was impossible to see anything and my work had to be done by the sense of touch. I soon found that reduction of the hernia could not be made unless the opening was enlarged. It was impossible to use a knife from below because the distended colon occupied the entire field. I did not like to lose the time necessary to get ready for a thoracotomy as the patient's condition was quite desperate.

I, therefore, decided to divulse the rent in the diaphragm until I could get enough of my hand in to make traction on the incarcerated viscera. This I did very gently and was able to grasp first the transverse colon which I brought down a little at a time, gradually overcoming the suction and adhesions until I had replaced all of the colon in the abdominal cavity. I then followed the same procedure with the omentum. After replacing the bowel and omentum within the abdominal cavity, I found the distention of the entire colon so great that it was impossible to close the incision. I, therefore, placed a purse-string suture in the distended colon, introduced a gall-bladder trocar and cannula through the middle of the area circumscribed by the suture and evacuated sufficient gas and liquid fæces to collapse the bowel. The cannula was carefully withdrawn, the purse-string suture drawn taut as it emerged, the bowel replaced, and the incision closed in the ordinary manner. The patient made an uneventful recovery and left the hospital on the seventeenth day.

During his convalescence he refused to consider a second operation to close the rent in the diaphragm. I insisted on his returning at a later time and allowing me to do this in order that he might escape further trouble, but he would not do so. In response to repeated efforts to get him to come in order that I might examine him as to the advisability of operating to repair the diaphragmatic rent he finally came, December 9, 1922, and we were able to make a roentgenographic examination of him. He also consented to be present at this meeting and I present him to you now. He says he has had no pain nor disability within the 2 years since the operation and apparently is in perfect physical condition today.

A few days after the operation I secured the following history which would have thrown light on the case the night of his arrival but, as stated, the patient's condition was so desperate that we did not take time for a careful history. He stated that 12 years previously he had been stabbed in the left side with a knife; 2 years before coming to me he had pain in his left side followed by vomiting which lasted a day or two and was followed by some obstruction of the bowels. He had had occasional cramps since that time. He had been told that he had chronic appendicitis and so stated the night of the operation. He also stated regarding his present ailment that he was loading a three hundred pound pole of wood, and when he lifted it up and laid it down he felt a keen pain in his left side, but worked on nearly 2 days with his side still hurting him, the pain gradually extending over his entire abdomen. He commenced vomiting 2 days after the pain began and had had no passage from the bowels since the pain started and had vomited until he was brought to the sanatorium.

As stated at the outset this case came to us in December, 1920, one year before the last meeting of this society, and every quotation from the literature used in this paper comes from papers printed in 1920, 1921, 1922, which, of course, were not available when I operated on this patient. The case has led me far afield into a most interesting study of the recent literature, and the surgical technique of operators in America, Germany, France, and England has been compared.

P. E. Truesdale[1] in the *Journal of the American Medical Association*, 1921, outlined the literary history of this subject from 1610, when the first two cases were reported by Paré, to 1853, when a monograph by Bowditch appeared. This latter author compiled 88 cases, comprising all cases in the literature up to September, 1921, since which time about 43 cases from battle wounds had been added to the literature by the recent war. The same author,[2] in the *Annals of Surgery*, in 1921, in discussing the frequency of operation for diaphragmatic hernia reports that Scudder found 53 cases recorded up to 1911, and Frank in 1919 could add only 41 additional cases. From 1918 to 1920, inclusive, 96 cases have been reported. Of the 96 cases collected 43 were the results of battle casualties, and he adds that the rapid increase in the number of operations for this condition is manifest, while there is no doubt that the number of cases treated and not reported is considerable. He states that intestinal obstruction is the outstanding factor of risk to life. In Scudder's series the surgical mortality was 75 per cent, essentially because of intervention during strangulation of the transposed viscera. Unlike this accident in other types of hernia the process is concealed and the symptoms and physical signs somewhat strange. Hence delay is the rule and the mortality exceedingly high. The operation mortality depends upon the number of cases encountered during acute intestinal obstruction. Warren reported 8 cases treated surgically during 10 years at the London Hospital. Only one lived. Seven were operated upon in the presence of acute obstruction. The general mortality after operation in the non-strangulated type averages 10 per cent.

Truesdale favors the thoracic approach to the diaphragm for the surgical treatment of diaphragmatic hernias. He says that the majority of American and British surgeons have preferred the abdominal approach, but that the French prefer the thoracic operation. But, of course, no one plan of approach is best suited to all cases. French surgeons also have used a third method which combined the thoracic and abdominal approach, and has been termed a "thoracolaparo-chondro-phrenotomy."

In connection with other statistics on diaphragmatic hernia, R. P. Rolands,[3] in *Guy's Hospital Report*, reports that Marshall Lloyd found only two cases recorded in the surgical reports of Guy's Hospital between 1866 and 1920. Both were due to crushing, and the patients died shortly after admission to the hospital without an operation. Out of 433 cases analyzed by Grosser and Thoma, 232 were congenital and 181 acquired, "but it is often very difficult to settle this point."

In comparing the abdominal and thoracic operations the author states "in 52 traumatic cases without strangulation, analyzed by Binnie, the mortality for the thoracic route was only 9.6 per cent, compared with 50 per cent for the abdominal route; in cases with strangulation the mortality was 50 per cent for the thoracic route and 100 per cent for the abdominal (Neugebauer). Scudder analyzed 55 operations: 11 thoracic with 7 recoveries; and 42 abdominal with 7 recoveries. It is possible, however, that the abdominal route was adopted in the most severe cases on account of signs of associated injuries in the abdomen."

D. L. Borden writes in a recent article (1922) that up to the beginning of the Great War, 650 cases of diaphragmatic hernia had been reported in the literature, and that only 15 of this number had been diagnosed before operation or autopsy, but that the roentgen-ray has demonstrated with great efficiency this pathological condition without waiting for operation. Since the onset of the war an increasing number of cases has been re-

[1] Truesdale, P. E. J. Am. M. Ass., 1921, lxxvii, 993-998.
[2] Truesdale, P. E. Ann. Surg., 1921, lxxiv, 347.
[3] Rolands, R. P. Guy's Hosp. Rep., 1921, lxxi, 91-101.

ported. Borden adds that a recent communication from the Mayo Clinic states that no cases of diaphragmatic hernia have been observed in their hospital since those reported in 1916 by the late Dr. Beekman, and he reported only 3 cases, 1 seen in 1909, 1 in 1911, and 1 in 1916.

Borden says regarding treatment: "Unquestionably the abdominal route is the one of choice." But he adds: "When adhesions prevent the reduction of the hernia from below, a thoracotomy, though adding to the operative risk, may be necessary to enable the operator to free the hernia from above and restore its contents to the abdominal cavity. When a traumatic opening exists in the chest, as in some wounds or other cases, the hernia may be repaired through it from above."

E. C. Roos in a recent (1921) paper says that there are two methods of surgical treatment of these hernias, the transpleural and the transperitoneal, and that the former is perhaps the better method as it permits a better exposure and a freer manipulation of the hernial contents, and also allows a better closure of the hernial openings. Further, with the present method of producing anæsthesia in thoracic surgery, this method is gaining in favor.

He also says that if the transperitoneal route is used, the various steps necessary in treatment have to be carried out at a great depth and more or less blindly, although a better approach may be obtained by a resection of the costal arch.

After a careful search of the literature following Truesdale's paper which appeared September 24, 1921,[1] I have been able to collect 13 additional cases of frank traumatic origin including the one reported by Dr. Stone last year, which occurred in March, 1918.

On the two sides of the important question of surgical technique a study of the literature showed the following advocating the thoracic approach: C. B. Keenan, G. Cotte, M. B. Gordon, D. L. Golann, Sauerbruch-Schumacher in early cases, R. P. Rolands, Llobet, Cranwell, Carson, and Barton. Rolands states that very few recoveries have followed operation, especially when the abdominal route has been adopted.

The following advocate the abdominal approach: S. Barling, A. D. Bevan, Dehelly, W. H. Holmes, L. F. Huffman, A. E. Keown, F. S. Matthews, H. M. Imboden, Nieden, Reichel, T. F. Riggs, Balfour, H. E. Waxman, and O. Orth, the last named advising abdominal approach when ileus predominates.

Garre prefers the abdominal approach in simple cases, and, in advanced cases with suspected gangrene, the thoracic approach; L. Prat, Sauerbruch, and Truesdale report thoracic approach in one case and abdominal approach in another case.

From the foregoing it will be seen that there is a wide divergence of opinion as to the relative merits of approach. I believe the condition of the patient at the time he is first seen should determine largely our decision in this important matter. Where symptoms of strangulation and ileus are apparent, the abdominal approach is an absolute necessity. Where the case is a chronic one and the diagnosis has been clearly established and confirmed by X-ray before operation, I believe the combined approach is indicated. From the experience gained in the case herein reported I feel that every preparation for the double operation should be made in advance provided the diagnosis has been made in advance. The abdominal incision should be made first and if reduction can be successfully performed and access can be had to the rent in the diaphragm it might not be necessary to open the chest.

In the case reported had I been able to diagnose the condition in advance, the chest could have been prepared, the proper instruments assembled, and when it was evident that the suture of the torn diaphragm could not be done from below a rapid thoracotomy would have made it possible to repair the rent. In this event an assistant with his hand in the abdomen can be of vast benefit to the operator by controlling the viscera and elevating the diaphragm from below while the operator works from above through the thoracic incision. However, I do not believe my patient would have survived had I undertaken a thoracotomy to suture the diaphragm after

[1] J. Am. M. Ass., 1921, Sept. 24.

relieving the obstruction. He was dying from intestinal obstruction and I operated to save his life by relieving the obstruction. He recovered because the operator preferred an incomplete operation and a live patient to a technically perfect surgical feat and a fatal result.

I wish to add to my own paper the following recently reported cases which are typical examples of traumatic hernia of the diaphragm:

C. B. Keenan in Ann. Surg., 1922, lxxv, 625, reports two interesting cases, both of which were successfully operated on by the thoracic approach.

Nieden in Muenchen. med. Wchnschr., 1920, lxvii, 1188, reports a case of strangulated hernia with complete retention of fæces for 1 week, the patient having been run over 1 year before present illness began. He did a laparotomy with median incision and after replacing the herniated transverse and descending colon, spleen, and greater omentum, he sutured the rent in the diaphragm from below. After the operation was completed severe symptoms of pneumothorax set in but disappeared when thoracotomy was performed.

A case which is strikingly similar to mine was reported by H. E. Waxman, in J. Am. M. Ass., 1922, lxxix, 123–124. It occurred several years after a bullet wound of the chest, and was strangulated, causing intestinal obstruction. It involved the splenic flexure of the colon and was complicated with acute appendicitis. The appendix was removed and the hernia reduced through the same incision. In his case the result was fatal.

CONCLUSIONS

Our fellow member, Dr. H. B. Stone, at the meeting of this association last year, in his judicial discussion of the question of approach seems to me to have fairly presented the subject from both angles. I believe his conclusions are sound and deserve restatement and emphasis:

"1. Abdominal exploration is essential in the great majority of cases of diaphragmatic hernia.

"2. Thoracic approach greatly facilitates the necessary operative steps.

"3. The method of choice, therefore, for the routine handling of these cases should be by combined abdominal and thoracic incisions.

"4. These incisions are best made separately instead of by the French method of a continuous incision."

I wish to add a fifth conclusion:

5. The X-ray is a positive means of diagnosis in this condition and its use should never be omitted.

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FRACTURES OF THE FIFTH METATARSAL[1]

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WHILE the fifth metatarsal bone is less frequently broken than the other metatarsals, yet its attachments and configuration undoubtedly make it perhaps most frequently the seat of fractures by indirect violence. Nion (1) collected 233 cases of metatarsal fractures and found that of these 112 were of the second, 98 of the third, 17 of the fourth, and but 6 of the fifth. Piersol (2) states that of the metatarsal bones, the first, although the strongest, is most frequently broken because it carries so large a proportion of the body weight and because it receives an undue share of the violence in falls associated with eversion of the foot. He contends, moreover, that the fifth comes next in frequency because of its exposed position on the outer side of the foot and the added violence in cases of inversion.

Prior to 1902, textbooks taught that *all* metatarsal fractures were produced by direct violence. In that year Sir Robert Jones himself sustained a fracture of the fifth metatarsal which occurred while he was "dancing somewhat vigorously" and his paper brought out the fact that fifth metatarsal fractures by indirect violence are of rather common occurrence. In 1905, Lilienfeld (3) analyzed 600 fractures and found that among them there were five fractures of the tuberosity of the fifth metatarsal and of these, three were by indirect violence, and two were by direct. Of some interest in this connection may be mentioned that he also discovered in this series seven fractures of the posterior tubercle of the astragalus and of these five were associated with a fracture of the calcaneus.

In 1908, Wharton (4) reported 3 cases of fracture of the proximal end of the fifth metatarsal by indirect violence. The patients were 45 years, 10 years, and 10 years, respectively, and they were satisfactorily treated by immobilization in plaster-of-Paris for 2 weeks.

The fifth metatarsal is a short, sturdy bone consisting of a base, a shaft, and a head. The base is very oblique and its inner two-thirds bears a facet for articulation with the cuboid. The outer part of the base is prolonged as the tuberosity beyond the edge of the foot, overhanging the joint. The inner side has a facet for the fourth metatarsal bone. The head, like the shaft, is compressed from side to side, and it has a pair of lateral tubercles at the dorsal aspect of the end of the shaft which are separated by a groove from the articular surface. Lateral ligaments are attached both to the tubercles and the grooves. The articular surface at the head is oblong and extends well onto the plantar surface.

Of particular interest in fractures of the fifth metatarsal, especially those by indirect violence, is the anatomy of the base of the fifth metatarsal. (See Fig. 7.) In the first place the marked protrusion of the tuberosity beyond the lateral line of the shaft and the lateral border of the anterior two-thirds of the foot make it particularly exposed to external violence which is directed toward the side of the foot. In consideration of the etiology of fractures of the tuberosity of the fifth metatarsal by indirect violence, the number of structures attached to it is very significant. First, there is inserted, on the dorsal aspect, the peroneus brevis muscle. This muscle arises from the lower portion of the lateral surface of the fibula and from the intermuscular septa. Its fibers join a tendon which passes behind the external malleolus. Its action is to extend and evert the foot. Second, there is inserted in the plantar lateral aspect of the tuberosity a portion of the abductor digiti quinti muscle which arises from the under surface of the calcaneum and from the plantar aponeurosis and the action of which is to abduct and flex the little toe. Third, the outer portion of plantar fascia is a strong band running from the tuberosity of

[1] Read before Chicago Surgical Society, March 2, 1923.

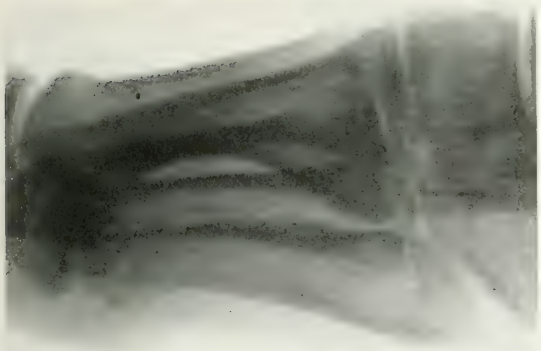

Fig. 1. Case 2. Patient twisted ankle when struck by an automobile. Probably a fracture by indirect violence.

Fig. 2. Case 3. Patient struck by an automobile and knocked down. The front wheel ran over the *internal* aspect of the ankle. Probably indirect violence.

the os calcis to the tuberosity of the fifth metatarsal (5). Fourth, the abductor ossis metatarsi quinti is a muscle which is occasionally present and runs from the os calcis to the tuberosity of the fifth metatarsal. Fifth, the flexor brevis minimi digit muscle arises from the inferior surface of the tuberosity of the fifth metatarsal and is inserted by a tendon into the outer surface of the base of the first phalanx of the fifth toe and also into the distal portion of the fifth metatarsal.

Moreover, of less interest to the fractures of the tuberosity perhaps than to those of the base as a whole are the following structures: first, the peroneus tertius muscle which arises from the fibula and interosseous membrane, and the tendon of which after passing through the lateral compartment of the anterior annular ligament is inserted in the anterior surface of the base of the fifth metatarsal bone. Second, the ligamentous bands which run from the cuboid to the fifth metatarsal, and third, the part of the plantar calcaneo-cuboid ligament which runs from the cuboid to the base of the fifth metatarsal.

To the shaft of the fifth metatarsal are attached, first, the third plantar interosseus muscle and, second, the first dorsal interosseus muscle.

In discussing the mechanism of fractures of the base of the fifth metatarsal, Sir Robert

Fig. 3. Case 4. Patient's foot subjected to a severe squeeze. Direct violence.

Fig. 4. Case 5. Patient struck by the fender of a cab and thrown violently to the pavement. Probably a fracture by indirect violence.

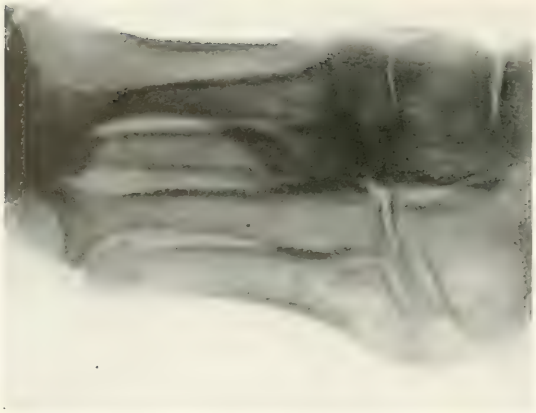

Fig. 5. Patient C. C. (St. Luke's Hospital No. 161861. Dr. Albert E. Halstead.) Foot run over by the wheel of an automobile. Direct violence.

Fig. 6. Case 6. Patient stepped down off of a step ladder and violently twisted her foot. Fracture of the distal extremity of the fifth metatarsal by indirect violence.

Jones (6) says that it is a cross breaking strain directed anteriorly to the metatarsal base, and caused by body pressure on an inverted foot while the heel "is raised." The prominent base of the fifth metatarsal is closely bound to the cuboid and to the fourth metatarsal by strong ligaments on every side. Jones contends that these ligaments are so strong that dislocation of the base is the rarest of accidents and that it is easier to break the bone than to dislocate it. When the heel, therefore, is off the ground, the body weight expends itself upon the fifth metatarsal, rotating it slightly inward. The opposition to this force takes place at its base where the strongly attached ligaments resist its displacement.

The frequency with which the tuberosity alone is broken cannot but attract attention to the structures attached to it. To it are attached the peroneus brevis, the abductor digiti quinti, the outer portion of the plantar fascia, the flexor brevis minimi digiti, and, occasionally, the abductor ossis metatarsi quinti. All these structures are strongly stretched by a sudden inversion of the foot particularly with the heel off the ground, and it is not to be wondered at that the tuberosity, their common attachment, is torn loose.

Fractures of the base of the fifth metatarsal or of the tuberosity alone are undoubtedly very common, but their recognition is not always easy, and they are frequently diagnosed as a sprained ankle and the convalescence is troublesome and prolonged. Mock (7) reports a case which came to him in his first year of private practice. The patient had twisted his foot jumping out of bed. A diagnosis of sprained ankle was made but another surgeon, by means of the X-ray, found a transverse fracture just below the tuberosity of the fifth metatarsal.

In making a diagnosis, the history of a twist of the ankle—a sudden inversion—is of importance. Not infrequently the patient is in an automobile accident and may ascribe his foot injury to some part of the automobile striking his foot. It is probable that in the effort to avoid the automobile that the patient violently twists his ankle and thus causes a fracture by indirect violence. There is generally no crepitus, no deformity, no yielding on manipulation. There is a tender point at the base of the fifth metatarsal and when the patient attempts to flex his toes or attempts to invert the ankle there is pain.

The treatment is generally simple. Immobilization in a plaster cast for 2 to 3 weeks, this to be followed by baking, massage, and cautious use. Operative interference may be demanded. Young (4) reports a case in which union did not occur and removal of the distal end of the first, the fifth, and then the fourth metatarsal was employed.

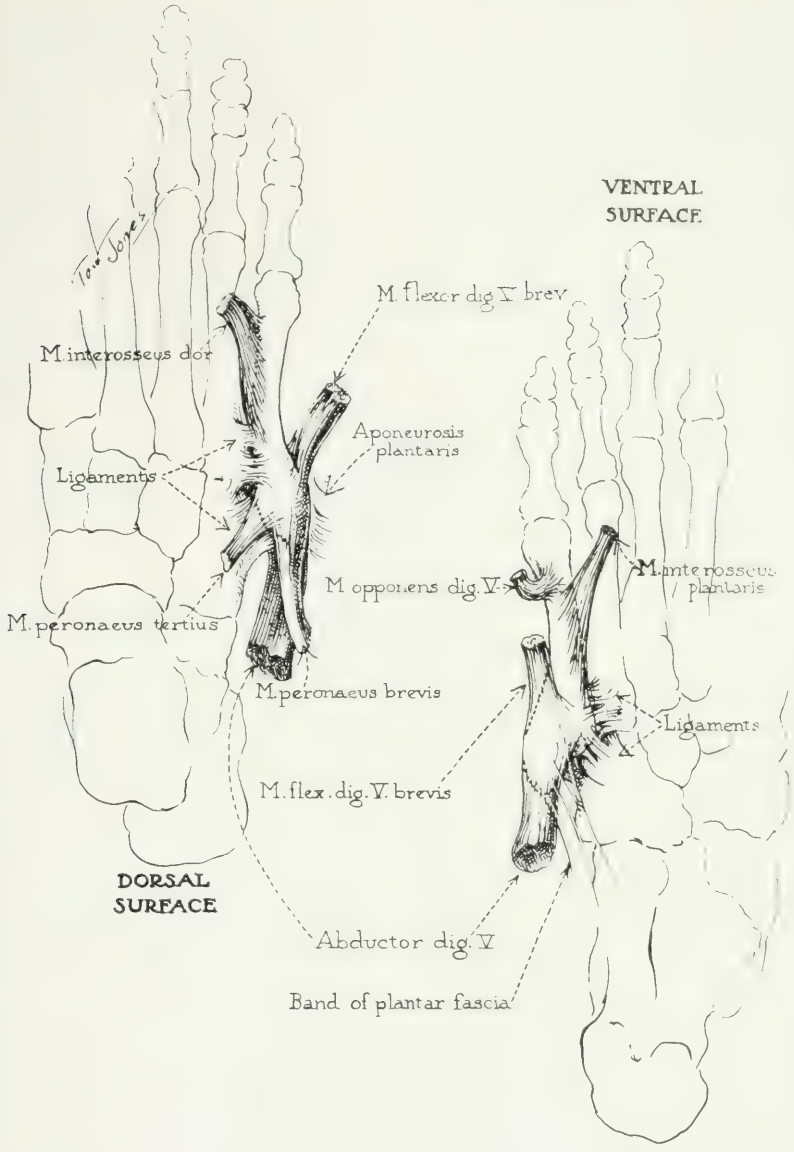

Fig. 7. Drawing showing anatomy of fifth metatarsal—ventral and dorsal surfaces.

The following cases are good illustrations of the condition.

Case 1. Mrs. E. (author's case), a stout woman of some 45 years turned ankle suddenly and experienced a sudden severe pain. X-ray showed a fracture at the base of the fifth metatarsal. Treatment plaster cast for 10 days.

Case 2. P. T. (case of Dr. Harry Mock, St. Luke's Hospital). Patient twisted ankle when struck by automobile and sustained a fracture of the fifth metatarsal, probably by indirect violence although patient's shoe was torn.

Case 3. J. D., male, age 56 (case of Dr. Albert E. Halstead, St. Luke's Hospital No. 147574). Patient was knocked down by automobile and wheel ran over *inner side* of ankle. This seems undoubtedly to have been a fracture of the fifth metatarsal by indirect violence. Treated by a cast.

Case 4. K. W., male, age 35 (case of Dr. L. L. McArthur, St. Luke's Hospital No. 151931). The machine the patient was driving was struck by a

freight train and the patient's left foot was pinched between the coupling on the car and the clutch pedal of his automobile. This may have been a fracture by direct violence.

Case 5. J. S., female, age 54 (case of Dr. Albert E. Halstead, St. Luke's Hospital No. 1490021). Patient struck by the fender of a cab and thrown violently to the pavement. In this case the fracture was undoubtedly one by indirect violence as it is unlikely that the fender could strike the patient's foot.

Case 6. Mrs. P. (author's case). Patient twisted foot in falling from the first step of a step ladder. In this case there was a linear fracture in the center of the distal extremity of the shaft of the fifth metatarsal. The explanation of this fracture might be the sudden pull of the third plantar interosseous upon the mesial side of the shaft of the bone.

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PAPILLOMA OF POSTERIOR URETHRA—THE CAUSE OF PROFUSE HÆMORRHAGE AND URINARY RETENTION

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PAPILLOMATOUS or polypoid tumors of the urethra are not exceedingly rare. The following case, however, presents features of interest in view of the quite unusual character and the severity of the symptoms, and on account of diagnostic difficulties encountered. A very small pedunculated tumor of this type, located in the prostatic urethra, was in this case responsible not only for retention of urine, but also caused bleeding so profuse in amount as twice to require evacuation of clots from the bladder through a suprapubic incision. It is of further interest to note that the blood regurgitated into the bladder, and was not voided through the urethra.

CASE REPORT

History. The patient, male, aged 50, with a negative past history, dated onset of present illness to November, 1917, with an attack of acute retention of urine, occurring without apparent cause and requiring catheterization. During the succeeding four years patient noted urinary difficulty, characterized by periods of frequent urination associated with straining and dribbling. There was no blood observed. No urological examination was made during this period.

In February, 1921, there occurred a sudden and profuse urinary hæmorrhage, accompanied by retention of urine and distention of the bladder with blood clots. Catheters and metal instruments were passed easily into the bladder, but on account of the large amount of firmly clotted blood it was not possible to relieve the patient by aspiration.

Suprapubic cystostomy, February, 1921. As an emergency procedure, the bladder was opened through a suprapubic incision by Dr. Donald Macrae, and a large amount of thick, firm clot evacuated. The most minute inspection at this time revealed merely a normal bladder mucosa. There was no apparent source of bleeding, nor was blood seen coming from either ureteral orifice.

Postoperative history. The patient's immediate convalescence was uneventful. There was no further bleeding. The suprapubic fistula, however, continued to drain, in spite of two operative attempts at closure, and in spite of a retained urethral catheter. When seen 8 months after operation, he was able to pass approximately half of the urine through the urethra, with considerable difficulty.

General physical examination at this time was negative. Rectal examination was negative. Cystoscopy revealed nothing further than chronic inflammatory changes in the bladder. Examination of the posterior urethra with an endoscope was likewise negative. The patient became dissatisfied and left the hospital with suprapubic fistula persistent and without a diagnosis.

In February, 1922, one year after operation, profuse hæmaturia suddenly recurred, again distending the bladder with clots. As on the former similar occasion, although it was easily possible to pass instruments into the bladder, efforts to relieve the patient by aspiration of the blood clots were unsuccessful. There was, therefore, no recourse but suprapubic incision.

Second suprapubic cystostomy, February, 1922. The bladder formed a firm, tense, visible tumor, extending to the level of the umbilicus. Incision revealed several ounces of bloody urine, and an enormous quantity of firm, thick clot, which was removed by the handful. As on the previous occasion, the most deliberate inspection, with a good exposure and light, revealed no papilloma or other source of bleeding.

Second postoperative history. Again the bleeding ceased while the suprapubic fistula and the urinary difficulty persisted. Cystoscopy, ureteral catheterization, functional kidney test and bilateral pyelogram, 2 months after operation, revealed a normal kidney on either side. A second urethroscopy was likewise negative.

A review of the history at this time, and a consideration of the two outstanding symptoms (profuse recurrent hæmaturia and urinary obstruction), in spite of the preceding negative urethral examinations, compelled the diagnosis of urethral tumor. This opinion was dependent also upon the normal bladder and the unobstructed urethra. A third urethroscopy, under a general anæsthetic, was accordingly undertaken.

Urethroscopy, March, 1922. The internal vesical sphincter was seen to close normally. Verumontanum was normal. Walls of prostatic urethra were normal, except for chronic inflammatory changes. The endoscope (Buerger cysto-urethroscope) was slowly withdrawn a distance that seemed to be about 2 centimeters beyond the verumontanum, when the pedunculated polypoid tumor shown in Figure 1 suddenly sprang into view. It was quite apparent that the tumor had been bent down by the withdrawal of the instrument, and consequently excluded from view until released by extreme withdrawal. This explained the previous negative urethroscopic examinations. The pedicle was attached to the inferior left aspect of the urethral mucosa, in about the 4 o'clock position. The tip was bulbous, and its surface very dark red and slightly lobulated, like the surface of a raspberry. Size of the bulbous tip was approximately that of the verumontanum. In the semi-transparent pedicle, blood vessels were visible. The point of origin of the pedicle was really membranous rather than prostatic urethra, because just after this point was passed, the characteristic "jump" was felt as the end of the instrument slipped through the opening in the triangular ligament, obscuring the tumor from view.

Fulguration. The tumor was destroyed by means of a fulguration electrode used through a cysto-urethroscope. Unfortunately no tissue was obtained for microscopical examination.

Subsequent history. The patient felt an immediate relief from urinary obstruction, and was able to pass a normal-sized stream without difficulty for the first time in 4 years. Slight suprapubic leakage persisted intermittently for a period of 3 months. Patient gained in weight and remained well while under observation (a period of 8 months).

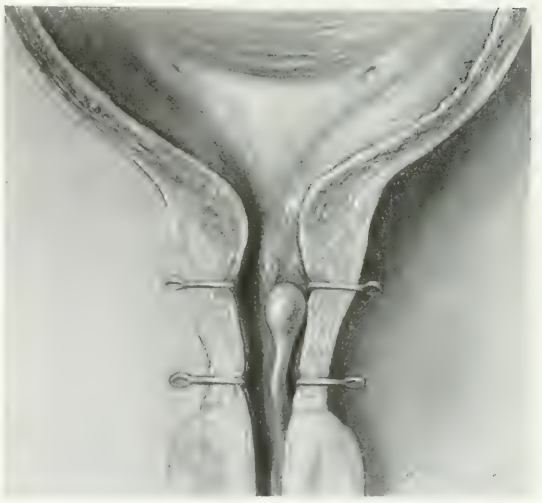

Fig. 1. Pedunculated, bulbous-tipped papilloma, springing from the urethral mucosa at the junction of prostatic and membranous portions.

PATHOLOGY

The literature pertaining to new-growths of the male urethra contains the most varied descriptive terminology, based mainly upon the gross appearance and not upon the microscopical pathology of these tumors. There are authentic reports describing cases of true carcinoma, sarcoma, adenoma (1), angioma (2), and fibroma (3), of the urethra. Randall (4) cites 25 cases of carcinoma and 10 cases of sarcoma. Our particular interest, however, lies with none of these but with that group of benign new-growths, more or less pedunculated, which have a superficial attachment to the urethral mucosa, which project into the urethral lumen, and which may be loosely described as being polypoid or papillomatous in type. Among others, are to be found the terms excrescence, vegetation, granulation tissue, caruncle, condyloma, urethral wart, papilloma and polyp, referring to these benign new-growths. Randall has given the classification of these tumors the most thorough consideration. After a microscopical study of specimens removed from fourteen cases, he has divided tumors of this type into three groups, as follows: (1) benign fibrous polyps, made up of loose fibrous tissue covered with normal urethral epithelium, and analogous to mucous polyps found elsewhere in the

body; (2) benign villous polyps, in which the epithelium shows papillary outgrowths; (3) benign glandular polyps, showing enclosed glandular acini.

It is difficult to draw a distinction between papillary projections of the urethral mucosa which are primarily neoplastic in origin, and those which are secondary to, or are associated with, chronic inflammatory changes in the posterior urethra. Those of the latter type are apt to be multiple in number and minute in size. A recent study by Player and Mathe (5) lays emphasis upon the inflammatory changes made out in microscopical section in all of a series of eight cases. These authors describe this type of tumor as being made up of either fibrous or glandular tissue, with an infiltration of small round cells and polymorphonuclears. Their classification is as follows: (1) true polypi with pedunculated bases; (2) polypoid masses with sessile bases; (3) simple œdematous excrescences.

DIAGNOSIS

Since the above case is quite unique with respect to symptomatology, it is of interest briefly to consider this subject. The vast majority of these patients have a history of gonorrhœa, and present symptoms of an irritative lesion of the posterior urethra—namely, chronic urethral discharge, urinary disorders (frequency and burning), referred pains which may be exceedingly varied in character, and sexual disorders. Profuse hæmaturia and mechanical urinary obstruction are among the rarer symptoms. In Randall's series of 14 cases there was only 1 case of hæmaturia, and none showed urinary retention. The cases reported by Player and Mathe included no case of either hæmaturia or retention.

It has been possible to collect five isolated cases somewhat similar to the one above reported, but in none of these has there been a history of a bladder distended by regurgitated blood. In 1891, Goldenberg (6) reported a case of urinary retention in a man of 59, relieved by removal of a polypoid "growth the size and shape of a split bean, attached by a broad pedicle to the upper and left wall of the urethra, near the bulb." Bryant's (7) case, a man aged 62, had both retention of urine and profuse hæmaturia. A cure was effected by the perineal operative removal of "a polypus the size of a haricot bean—attached to the floor of the (prostatic) urethra." Morrow (8) described multiple polypoid growths filling the bulbous urethra for a distance of an inch and a half, and removed by means of an endoscopic snare. Here also there was profuse urethral bleeding and there were obstructive symptoms. Marion's (9) case was one of complete urinary retention dating back over a period of several years. Cystoscopy and rectal examination were negative. After suprapubic removal of a small prostate, a large papillomatous growth, attached to the mucosa of the prostatic urethra, was found upon examination of the removed specimen. Culver's (10) patient, a man of 56, gave a history of urinary retention, not relieved following suprapubic prostatectomy. The fistula remained patent until subsequent examination revealed multiple papillary tumors of the posterior urethra, the largest attached to the verumontanum. Recovery followed removal by snare and fulguration.

These 5 cases from the literature of urethral tumor producing urinary obstruction, together with the 1 herewith presented, have several diagnostic features in common. In each, rectal examination was negative, as was cystoscopic examination, and in none did the urethra obstruct the passage of a soft rubber catheter. Hæmaturia, added to the above evidence may be considered almost pathognomonic, and under these circumstances negative endoscopy should be repeated.

TREATMENT

In treating these cases various methods have been used, including open operation, snare, and caustic application. Goldenberg reports having sliced off the pedicle of the tumor with the edge of the endoscope. Randall used rongeur forceps and applied silver nitrate to the base with good results. The method latest advocated, and probably the simplest and the most efficient, particularly for the smaller tumors of this type, is the use of the fulguration electrode. The chief objection to the latter method is that the specimen is destroyed for microcsopical examination.

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CONGENITAL RECTAL STRICTURE AS THE CAUSE OF INFANTILE MEGACOLON[1]

By VERNON C. DAVID, M.D., Chicago

HIRSCHSPRUNG described congenital idiopathic megacolon in 1886 and reported the history of several cases he had examined. Since that time, the condition has been generally known in literature as Hirschsprung's disease. Many doubts have been expressed, however, as to the idiopathic character of the disease and the question raised as to the importance of other congenital malformations in the gastro-intestinal tract, producing partial obstruction of the colon and acting as the cause of the megacolon. Hirschsprung, as well as Concetti, who later reviewed the subject, were well aware of this possibility and laid down as a premise that the cases of megacolon they were describing had no obstruction of the large bowel as a causative factor.

Hirschsprung's disease, as described by Hirschsprung, Concetti, and Neugebauer, has been characterized by dilatation of the sigmoid alone, in most of the cases reported. Next in frequency of involvement has been all of the colon except the rectum and then all of the colon including the rectum. The transverse colon or rectum has been affected alone in rare instances. In the forme condulante of Hirschsprung, a normal sized portion of bowel is present between the two markedly dilated portions. The cæcum, contrary to cases with obstruction of the bowel, is not ballooned out nor is the small bowel distended. The circumference of the affected sigmoid may be very greatly increased, reaching as much as 70 centimeters in circumference in one case reported. The thickness of the bowel musculature is not increased (Hirschsprung) as in obstruction of the bowel. Neugebauer, however, believes that the thickness of the muscularis is practically always increased, but cases have been reported where the bowel wall was so thin as to be transparent. There is a decided lengthening of the large bowel affected so that several loops of sigmoid may be formed. Biermans reported a transverse colon twice as long as normal and the sigmoid has been measured 78 centimeters in length in a child with Hirschsprung's disease. Contained in the distended loops of bowel are large accumulations of gas and fæces. In the impacted fæces, sandy particles of phosphates and fatty acids are found. Forty-seven pounds of fæces have been removed from a dilated colon which formed a tumor reaching from the symphysis to the ensiform cartilage. The dilated sigmoid is commonly found in the midline or to the right in contrast to its normal position. The haustral markings of the sigmoid are commonly lost and the folds of mucosa flattened. Pigmentation of the mucosa may be present and occasionally ulceration from pressure of

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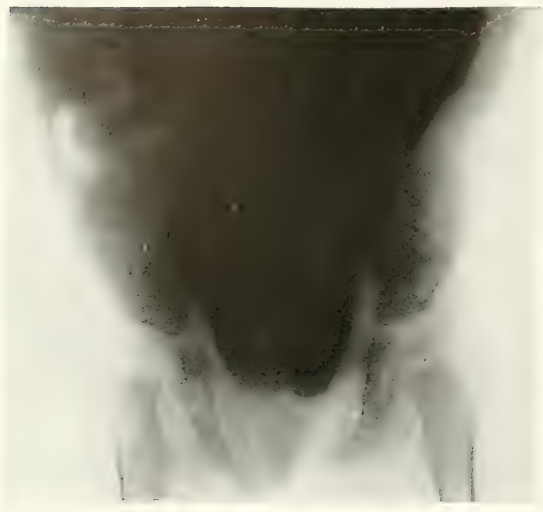

Fig. 1.

fæcal masses develops. Microscopic examination of the affected bowel wall reveals normal musculature, nerves, and blood vessels. Other viscera undergo changes consequent to the presence of a large abdominal tumor. The bladder is often enlarged, the liver is pushed to the right, the diaphragm is elevated. Disturbance of circulation from pressure on the vena cava and hydronephrosis from pressure on the ureter have been described.

Other theories of cause of megacolon. While Hirschsprung described the condition of congenital idiopathic megacolon, other authors (Marfan) have advanced the theory that the congenital defect consisted of an increased number of loops of colon and that distention of these loops to form a megacolon was due to rotation or angulation of these full loops with a consequent chronic obstruction of the bowel. In Neugebauer's collected cases, seventeen instances where volvulus had occurred were cited.

A kinking of the bowel may cause partial obstruction and at the site of the angulation a valve of mucosa may form. Such a condition was described in the literature by Jacobi as far back as 1868. This angulation usually occurs where the movable sigmoid passes over the promontory of the sacrum to become the rectum. At the rectosigmoidal junction, a normal physiological narrowing occurs as was described by Amussat, and a reduplication of the mucosa may frequently form a valve-like fold. This is exaggerated when the loaded sigmoid angulates at this fixed point (Laewen). This view obviously inclines to the belief that a mechanical hindrance to the fæcal stream is an essential etiological factor. Konjetzny reports the postmortem findings in a three-day-old baby with a large colon which he hardened in formalin by injecting the formalin into the blood vessels of the bowel. On examination of the specimen, he found transverse plications at the rectal valves of Houston and at the rectosigmoidal junction which prevented the flow of water from the sigmoid into the rectum. Plantogena reported a similar case which died 4 weeks after birth and which presented a similar valve at the rectosigmoid which prevented the flow of water from the sigmoid into the rectum.

Other mechanical causes have been reported, such as a spasm of the anal sphincter with or without fissure *in ano* (Fenwick-Wilms). While this condition may play a rôle in a few cases, it is not found commonly in children with a megacolon.

Another case was reported in which congenital angioma of the rectum was the factor causing the obstruction.

Insufficient innervation of the bowel has been mentioned as a cause but histological study and clinical observation do not bear this out.

Aplasia of the muscularis of the bowel is sometimes present but is probably secondary to pressure of the accumulated fæces and gas.

Diastasis of the recti muscles, chronic constipation, and dietary errors are contributing causes which may have a considerable bearing on the development of a megacolon. It hardly seems possible that these factors are the underlying causes in most cases.

Neugebauer has classified infantile megacolon as follows:

I. Congenital idiopathic megacolon (gigantism of the colon, Hirschsprung's disease);

II. Acquired megacolon

1. Congenital increase in length of colon by reason of excessive loop formation;

Fig. 2.

Fig. 3.

2. Rectal valve hypertrophy;
3. Spasm of the sphincters or bowel muscles.

To this classification should be added congenital stricture of the rectum as a causative factor in acquired megacolon.

The following cases are illustrative:

Case 1. Female, F. M., age 16 months, entered the Presbyterian Hospital on the service of Dr. Walter F. Winholt. The patient's complaints on entering the hospital were (1) heart trouble, (2) failure to gain, and (3) distended abdomen. Since birth the abdomen had been distended but more so during the past 3 months. The child has had bowel movements which are greenish-yellow and not watery. Weight at birth was 5 pounds and 5 ounces, and this weight has increased to between 9 and 10 pounds and remained stationary at that point.

Physical examination revealed a pale, underdeveloped, poorly nourished child with a distended abdomen. The abdomen was filled with a tumor reaching from the symphysis to the ensiform which was doughy and could be pitted on pressure. The abdominal wall was thin but when attempting to palpate the tumor, marked rigidity of the abdominal muscles resulted. The heart was enlarged to the right and left and a marked systolic blow was heard at the apex, which was transmitted over the entire chest. The posterior cervical and axillary lymphatic glands were enlarged.

Rectal examination revealed a very hard mass completely filling the rectum and bulging into the anal region, which was with difficulty differentiated from a bony deformity of the pelvis, or from a bony tumor arising from the pelvis. It was in reality the lower border of a very hard fæcal impaction. This was almost entirely separated from the examining finger by a diaphragm of mucosa which was about 3 centimeters distant from the anal orifice, and in the center of which was a small opening. This obstructing membrane resembled in form the iris of the eye with the central opening corresponding to the pupil. There was no rectovaginal fistula.

X-ray examination by barium enemas showed enormous dilatation of the sigmoid, which almost completely filled the abdomen.

Operation, July 26, 1922, by Dr. V. C. David. Circular anæsthesia of the rectum by injection of one-half per cent novocaine. A small speculum was introduced into the rectum and the opening in the obstructing stricture was seen to be about 4 millimeters in diameter. Beginning with a sharp pointed artery forceps, the opening was gently dilated. The smallest cervical dilator was now used and dilatation was increased until the opening was about 1 centimeter in diameter. At this point, the diaphragm was cut through in the direction of the long axis of the bowel and further dilatation employed until an index finger could be introduced through the stricture into the bowel above, which was filled with dry, hard fæcal masses. A considerable amount of this was removed. The mucosa was now mobilized by blunt scissor dissection so that the longitudinal incision could be sutured transversely. This assured a permanent widening of the strictured area which allowed the passage of the index finger through it. It was the thought of the operator to perform the same operation on another segment of the stricture if the first operation did not gain room enough.

After history. Oil retention enemas were given each day as well as repeated retention enemas of small amounts of water. On the fourth day the child passed a large amount of fæcal matter and the large mass in the abdomen disappeared. The strictured area was examined from time to time and the index finger passed through it. A number of small fæcal impactions were broken up and passed.

In August the patient developed diarrhœa, took her food poorly, and on August 22, died.

Autopsy by Dr. H. A. Oberhelman. The enormous enlargement of the sigmoid had disappeared although the bowel was hypertrophic and somewhat larger than normal. It in no way resembled the picture obtained by X-ray before dilatation of the stricture, where the sigmoid almost completely filled the abdomen. All of the fæcal impaction had been evacuated except one mass the size of a small peach which was in the lower sigmoid. The bowel completely enclosed the mass so that it appeared to obstruct the bowel, though there was no dilatation of the bowel above it. The stricture had remained dilated to the point where the index finger could be passed through it. The mesosigmoid was greatly enlarged and the cæcum could be moved to the extreme left portion of the abdomen. The heart showed a defect in the membranous septum. A Meckel's diverticulum was present.

This typical clinical picture of infantile megacolon associated with congenital heart defect, persistent Meckel's diverticulum, cæcum mobile and a very large mesosigmoid was caused by a congenital stricture of the rectum.

Case 2. W. M., male, age 4 years, entered the Presbyterian Hospital on the service of Dr. Dean D. Lewis, January 5, 1922, complaining of involuntary movement of the bowels and distention of the abdomen. For the first 2 years of his life, the bowels never moved spontaneously and enemas were used as a routine procedure. Since that time the movements have been spontaneous but involuntary. The child's general health was good. On abdominal examination a large mass was palpated in the region of the descending colon. X-ray shows a very large colon and an extremely distended sigmoid which crosses to the left side of the abdomen.

January 15, 1922. Median laparotomy (by Dr. Lewis) was performed and the sigmoid was found very greatly distended. Seven to eight inches in the sigmoid were resected and an end-to-end anastomosis made which was anchored extraperitoneally. Two days after the operation, the extraperitoneal bowel was opened because of marked distention of the abdomen.

April 6, 1922. The patient returned to the hospital with a colostomy opening. No fæces were passing through the rectum. I was requested to proctoscope the child and found a circular stricture of the rectum which barely admitted the tip of the index finger, about 5 centimeters above the anal orifice. Above this stricture was an impaction of fæces. This stricture was dilated by cervical dilators up to No. 21.

May 9, 1922. Patient was operated on by Dr. Lewis. Rectal dilators again passed and stricture still further opened by finger dilatation and accompanied by small incisions at the site of stricture.

September 1, 1922. The colostomy closed and bowel movements have now become spontaneous and voluntary through the rectum.

The fæcal impaction resulting from this congenital rectal stricture produced an enormous dilatation of the sigmoid resembling very accurately the clinical picture of Hirschsprung's disease.

Case 3. J. N., female, age 7 years, entered the service of the author at Children's Memorial Hospital, August 2, 1920. The patient has had incontinence of fæces since her birth, coming in attacks each week and occurring several times a week. These attacks occur without nausea or fever but are accompanied by some pain in the region of the umbilicus, and the presence of a mass in the abdomen. These attacks clear up with the passage of an enormous bowel movement. While she was in the hospital, she complained of considerable abdominal pain, there was marked distention of the abdomen and incontinence of fæces was present.

Examination revealed a pale child with marked distention of the whole abdomen, especially around the umbilicus, and associated with general muscular rigidity. No masses were palpable. Rectal examination revealed a sickel- or valve-shaped diaphragm occluding the anterior two-thirds of the rectum, about 3 centimeters from the anal orifice. Under ether anæsthesia, this membrane was divided longitudinally, the constricture was well dilated, the mucosa was mobilized around longitudinal incision and a transverse suture of the division was made (principle of Mikulicz). The index finger could now be passed through the strictured region with ease. After the operation the patient had normal bowel movements and no involuntaries. Before discharge from the hospital, the wound had healed and the rectum was well open.

This is not a typical picture of Hirschsprung's disease but it at least falls under the heading of fæcal impaction and incomplete obstruction of the bowel due to congenital rectal stricture.

These three cases emphasize the importance of purely mechanical factors in the production of megacolon which in two instances, at least, simulated very closely the clinical picture of Hirschsprung's disease. The relief of this mechanical obstruction by appropriate operative measures resulted in prompt regression of the megacolon.

In looking through the literature on Hirschsprung's disease and megacolon, there is little

mention of congenital rectal stricture as an etiological factor. Treves reported a case in 1898 of a child 5 years of age, which had had a megacolon from birth. A laparotomy was performed and the pelvic portion of the rectum was found to be tubular and no larger than an adult index finger. An opening was made in the dilated colon above the recto-sigmoid junction and an abnormal valve-like fold of mucosa found to lie over the rectal tube. Treves states his belief to be that megacolon in childhood and infancy is not usually idiopathic but dependent on some other definite obstructive factor.

No other record of megacolon in childhood associated with a congenital rectal stricture was found, though undoubtedly they have been observed. It is my belief that careful rectal examination in cases of infantile megacolon will bring to light etiological factors of importance in some of the cases.

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HYSTERECTOMY IN CERTAIN CASES OF PULMONARY TUBERCULOSIS; PARTICULARLY AS AN ALTERNATIVE FOR THERAPEUTIC ABORTION

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LITTLE need be said at this time of the advisability of therapeutic abortion in certain cases of pregnancy complicated with pulmonary tuberculosis. Reference to two leading authorities will suffice:

Maurice Fishberg, of New York, in the third edition of his book on *Pulmonary Tuberculosis* (1922), says (p. 580): "The vast majority of modern writers maintain that pregnancy, labor, and lactation are liable to reactivate latent tuberculosis, and aggravate active lesions, often leading to a fatal termination of otherwise favorable cases." In regard to the treatment of these cases he says (p. 675): "Married women with active tuberculosis are to be given detailed instruction in the proper methods of prevention of conception. If they become pregnant the induction of abortion is indicated and justified both for the sake of the prospective child, which is bound to become tuberculous unless removed from the proximity of the mother immediately after birth, and for the sake of the mother, who is liable to succumb to acute or subacute tuberculosis soon after childbirth."

F. M. Pottenger, of Monrovia, California (Surgery, Gynecology and Obstetrics, November, 1921, p. 353), in a discussion of tuberculosis in pregnancy, dwells quite at length on therapeutic abortions. He says: "Because of the serious effects of tuberculosis complicated by pregnancy upon the mother, interruption of pregnancy has now become the common rule in the treatment of tuberculous women, but if we follow up the after-history of these cases we cannot be other than convinced that even this measure fails in a large percentage of cases and the best way to safeguard the tuber-

culous woman consists in preventing conception. . . . The average patient with active tuberculosis, whether it be in the early or the late stage of the disease, is compelled to put up a hard fight to regain health. When the strain of pregnancy is added a strong adverse factor is injected. . . . Even at the best, however, pregnancy is a complication which must be considered as extremely hazardous for a tuberculous woman. Maragliano has been so impressed with its injurious influence in such cases that he says all sentiment should be thrown aside and pregnancy should be interrupted in the interest of the mother as soon as the diagnosis is made. . . . While interruption of pregnancy sometimes fails, it offers the patient the best chance to overcome her disease. The favorable effects are most evident, as would be expected, in the early cases. In these, improvement of the tuberculosis usually follows. The procedure is the least beneficial in the advanced cases, many of which are apt to go on to increased activity. It can be said of the latter type of patient, however, that her chances are undoubtedly improved by the operation. . . . Statistics show that early tuberculosis goes on favorably after the interruption of pregnancy in 87.9 per cent of the cases, and that 33.3 per cent of moderately advanced cases and 29.4 per cent of far advanced cases are benefited."

Case 1. February 18, 1922, a patient was referred to me by Drs. C. O. Probst, medical director of the Columbus Tuberculosis Clinic, and J. O. Welch, the patient's family physician, for the purpose of producing a therapeutic abortion. Mrs. H. S. T., age 42, married 20 years; one child aged 17. One miscarriage 13 years ago. Patient had been under the supervision of Dr. Probst for 4 years. She was in the State Tuberculosis Sanatorium at Mt. Vernon for a long while, and had taken precautions against pregnancy. She menstruated last in November. During the years that Dr. Probst had been in attendance she had had two relapses. He was consulted after it was found that she was pregnant, and after giving her case thorough investigation he felt that the uterus should be emptied as he thought a third relapse would be fatal. Examination of the patient showed her to be a slender woman with thin abdominal walls; uterus entirely movable, but apparently a little irregular in outline; some scar tissue in the cervix.

I had been called upon a number of times by different physicians to perform similar services, and had aborted with no idea of any other line of treatment; but while examining this patient it was suddenly impressed upon me that I could make a panhysterectomy in her case in about 15 minutes; there would be no hæmorrhage, no shock; there would almost certainly be prompt and complete convalescence; there would be no further pregnancies, and no loss of menstrual blood; whereas, if I merely emptied the uterus in the usual way, there would necessarily be more or less hæmorrhage, almost certainly more or less dribbling and leucorrhœa, and subsequent periodical loss of menstrual blood. The more I thought of this alternative the more favorable the proposition seemed. I talked it over, therefore, at once with her two physicians, and they promptly agreed with me in my suggestion, as did also the patient and her husband. The operation was made in the usual way, saving one ovary and its tube because of her comparative youth. Her appendix had been removed in 1913. She made an excellent operative recovery, has been entirely well since then as to her pelvic organs, and her general health is much better than it had been for years.

Case 2. Mrs. M. E. H., age 18, married 4½ months. May 1, 1922, patient was referred to me by Drs. Griffin and Probst. She had been first met by Dr. Probst at the Tuberculosis Clinic in November. Without seeking advice she was married in December. She menstruated last, February 15. She had been having weak lungs indefinitely, and there was a good deal of tuberculosis on both sides of the family. She had lost 16 pounds in weight in the last 3 weeks. She had had considerable leucorrhœa for the last year, and had had hæmoptysis twice within the last 10 days. I found the patient a very slender woman and so weak that she had to be helped by her husband across the sidewalk into my office. Everything indicated a normal pregnancy of the time mentioned. In this case, as in the other, the matter of hysterectomy was discussed with her physicians, and we all agreed on its propriety, as did the patient, her husband, and family. A panhysterectomy was made the following day, but both ovaries and tubes were saved. The appendix was removed. Patient made a rapid convalescence, and when seen a few weeks ago had gained 24 pounds in weight and was feeling perfectly well, and was very happy.

Case 3. Mrs. A. P., age 35, married 15 years; three children, youngest 8 years. Miscarriages, one. Patient had suffered from procidentia for years, the womb coming down between her thighs. She had been taking precautions against pregnancy. She had missed menstruation 3 months before. She had been studied by two physicians. She was having a good deal of cough and a great deal of expectoration, with febrile disturbance. On examining her I found a very slender sick woman, clearly pregnant. There was a suspicion of a tumor involving the right horn of the uterus; a rather boggy uterine mass; deep laceration of the cervix; a large rectocele; pulse 124 and feeble; prolonged expiratory murmur over both lungs with now and then râles. I talked over her

case with her physicians and husband, and hysterectomy was decided upon with perineal repair. The operation was done June 29, 1922. I did an abdominal panhysterectomy but saved the left ovary and tube. I removed the appendix. After completing the operation I made a posterior colporrhaphy and perineorrhaphy and extracted some bad teeth. Patient made a prompt recovery, and has been repeatedly reported by her husband as "in fine shape."

Case 4. Mrs. C. B., age 28, married 5½ years; one child age 3 years. Normal labor; no miscarriages. Patient had never been really well since the birth of her child. She was at Tucson, Arizona, for 10 months for tuberculosis. She returned home October 1, 1922. She commenced ailing almost at once with colds, etc. She never had any profuse expectoration but the microscope had shown tuberculosis. She became pregnant about the first of January and had been running down very rapidly since then. She had a good deal of leucorrhœa, and an unusual amount of vomiting of pregnancy. She had had several hæmorrhages. Dr. Danford had made a diagnosis of acute exacerbation of her tuberculosis, and sent her in with the idea of hysterectomy instead of therapeutic abortion. Dr. Harper, of the Tuberculosis Clinic, found ample evidence of tuberculosis of both lungs. In one apex he thought it had healed, but there was a patch of active tuberculosis in the other apex. He heartily approved of Dr. Danford's suggestion of hysterectomy. My examination was limited to the pelvis. It showed a good perineum and vagina, some scar tissue in the cervix, the parts quite tender. She had been clearly pregnant about 2 months. February 10, 1923, I did the usual panhysterectomy, but saved both ovaries and tubes. The round ligaments were implanted. The appendix, bedded in adhesions and thick-walled, was removed. Examination of the uterus showed it to be considerably larger than would be expected with a pregnancy, so that she probably had had a good deal of hyperplasia before becoming pregnant. This patient is convalescing beautifully, but the operation is too recent for any conclusion.

From making a hysterectomy instead of a therapeutic abortion in pregnant women with pulmonary tuberculosis, it was a natural step to extend the operation to tuberculous women in whom pregnancy would be highly undesirable, and who were handicapped by the monthly loss of blood, profuse leucorrhœa, or uterine hyperplasia with all its distressing symptoms of backache, bearing down, dyspareunia, etc. Two such cases presented themselves at this time, and the suggestion was carried into effect.

Case 5. Mrs. I. M. E., age 32, married 8 years; two children, the youngest aged 3 years. No miscarriages. Patient was seen August 13, 1922. Menstruation had been regular, but the flow large and frequently with clots. She had some leucorrhœa; much backache. She tires easily. She has pronounced dyspareunia. She has had lung trouble for 3 or 4 years. Weight 90 pounds. Her case had been studied at the State Sanatorium at Mt. Vernon, and she had made arrangements to enter the institution within a few weeks. On examining her I found a good vagina and perineum; lacerated cervix; the uterus enlarged and quite tender. I discussed her case with her family physician, and we both advised hysterectomy. She was operated upon August 18, 1922. I did the usual panhysterectomy except that both ovaries and tubes were saved, the appendix was removed. Patient made a prompt recovery, and a month later entered the Tuberculosis Sanatorium as had been planned, for a prolonged rest. Three months later she reported that she had gained 19 pounds in weight, had a fine appetite, was sleeping well, pulse and temperature within normal limits, and she was feeling better than she had felt for years.

Case 6. Mrs. H. W., age 29, married 8 years; five children, age of youngest 3½ months. No miscarriages. Patient was seen September 7, 1922. She had been dribbling ever since the birth of the last child. This child and two others were dead. She had always been slender, but had been losing flesh since the last child was born. She was chilly at times, and had a continuous fever. She had been coughing a good deal for 2 months. I found her a very slender woman, and relaxed perineum and vagina; lacerated cervix; uterus enlarged and very tender; abdominal walls thin. Sputum was examined and pronounced tuberculous. Operation September 9, a panhysterectomy except that the left ovary and tube were saved. I removed the appendix, and closed the incision and then made a repair of the posterior vaginal wall and perineum. I extracted a few bad teeth. The patient made an excellent operative recovery, and went home in due time.

This patient was farther advanced in her disease than any of the others. She was a foreigner and decidedly pessimistic. Her physician told me that her home environment was unfavorable, and she opposed my suggestion as to her entering the Tuberculosis Sanatorium. She went home feeling much better than when she came for her operation, and later the doctor reported that she was in most respects much better than before, but that the disease was progressing and he did not believe the ultimate result would be otherwise than a fatal termination. He was sorry that she had not been sent in for operation while the disease was in an earlier stage.

Soon after operating on these cases I wrote to Dr. Pottenger, asking his opinion of the procedure, as I felt he had had an enormous experience and a remarkably wide field of observation. Under date of October 26, 1922, he writes:

"I believe that you have devised a method of satisfactorily taking care of a certain group of tuberculous cases complicated by pregnancy. I do not believe it would be necessary in all, but in advanced cases I can see how it would offer a maximum benefit with a minimum of physiologic disturbance.

"Since dictating the above I have been thinking of the explanation of why your hysterectomy patients did so much better than those in whom a therapeutic abortion is performed. In tuberculosis we find that women are very apt to have an increased activity, accompanied by increased symptoms, including temperature—usually coming on either a few days before the period or immediately following it. In accordance with the theory of Jobling and Petersen, this is probably due to the fact that at this time new enzymes, those associated with the function of menstruation, are thrown into the blood stream and that the antiferment which is binding the enzymes which break down the tuberculous tissue are released from the tuberculous enzymes and for the time being bind the enzymes connected with menstruation. As a consequence of this, the tuberculous enzymes become active and there is very apt to be an increase in autolysis in the tuberculous focus. Now, this same thing happens following the therapeutic abortion or delivery at term. The involution of the uterus, following delivery, is carried on by enzymes, and these gaining access to the blood stream, bind the antiferment and free the tuberculous enzymes to carry on the digestive process about the tuberculous focus.

"While this may not be the exact explanation, it certainly gives us a working conception that offers a plausible explanation for the thing that we all see happen. Hysterectomy, by removing the uterus, relieves the necessity of involution and thus saves the patient the danger which comes from the extra enzyme action during that time."

In his letter Dr. Pottenger thinks that he has seen in some German journal a reference to the same operation, but thinks the matter was never followed up.

Investigation through Dr. Ramsay Spillman, of the Library of the Surgeon General's Office at Washington, results in finding but one article suggesting anything along this line of treatment, and that article is probably the one referred to by Dr. Pottenger. This article is by H. von Bardeleben.[1] In this paper the author recommends merely such a partial amputation of the body of the uterus as will remove the placental site, since, according to him, the placenta is frequently tuberculous and may thus reinfect the patient. He reports a number of cases but without details.

Bandelier and Roepke[2] refer to the article by von Bardeleben, and advise the removal of the uterus when that operation becomes necessary in advanced pregnancy. They advise against the removal of the appendages in these cases because of trophic, vasomotor, and psychic disturbances which would be apt to follow, and which might favor the extension of the tuberculous process.

A good many years ago I operated upon an unmarried woman, age 26, who was apparently hopeless from a generalized tuberculosis. Both lungs were involved, there had been quite rapid loss of flesh, profuse diarrhœa, loss of appetite, etc., while in addition there was involvement of one elbow, the joint being disorganized and greatly enlarged, with multiple sinuses; also a sinus going down to the posterior superior spinous process of the ilium; cough with much expectoration, and amenorrhœa of six months' standing. The case seemed so hopeless that I finally operated only at the insistence of the mother. Resection of the joint, to get rid of the source of most of her pain, showed that the disease had extended nearly to the upper end of the humerus and downward nearly to the wrist; accordingly amputation was made just below the shoulder. The wound healed by first intention, and for the first time in many weeks she was able to have a night's rest. A few weeks later I removed the detached spinous process. Improvement was very rapid, and a few months later she had apparently been restored to full health. I kept track of the case until she left the city about 10 years later.

This case presents a distinct illustration of what I have seen repeatedly, though in less marked cases; viz., after getting rid of a large part of the tuberculous disease, nature asserts herself and the patient recovers from what remains. It has seemed to me that this case was a fair illustration of what we might expect to gain by putting a stop to the menstrual loss

[1] Med. Klin., 1912, viii, 1592-94 and 1636-40.
[2] Die Klinik der Tuberkulose. 3d ed. Wuerzburg, 1914, p. 497.

of blood, or by getting rid of a more or less diseased uterus which is handicapping the patient.

Since making the first operation I have talked with a considerable number of physicians, and have corresponded with others, and I cannot find that this line of treatment had previously been suggested, and yet it has seemed to impress all with whom I have discussed it as an exceedingly reasonable proposition. One of the surgeons of the Woman's Hospital in New York, with whom I discussed the matter a few months ago, was particularly impressed with it, and expressed regret that he had not thought of it some time before when he had simply emptied the uterus in a case referred to him, the abortion being attended not only with immediate hæmorrhage but with dribbling of blood for four months.

Nature has suggested this line of treatment by herself putting a stop to menstruation in very many cases, particularly in young women, at the very beginning of pulmonary tuberculosis.

This paper is not designed as an argument for indiscriminate hysterectomy in cases of tuberculosis, but as a plea for that operation in properly selected cases, and after due consultation with the internist, the friends, and particularly the patient herself.

I stated that in these cases, where there are no complications and the patient is of reasonably spare build, a hysterectomy can be made in 15 minutes from the first incision to the adjustment of the last stitch in closing the wound. This means that the entire womb is removed, so that no cervix is left for future trouble; the round and broad ligaments are brought in so as to support the vagina; there is complete peritonealization of the floor of the pelvis; the appendix is removed; the gall bladder examined, and the incision closed in layers as usual. If there are extensive adhesions present, or perineal repair necessary, the time will be somewhat increased, but except under extreme circumstances no *competent* operator should require over 30 minutes for an operation of this kind.[1]

Ether. I have operated many times on more or less advanced cases of pulmonary tuberculosis, and have invariably used ether by the open drop method. I have never seen the slightest evidence of any trouble arising from its use, and it is well known that not long ago certain physicians were advising prolonged etherization as a therapeutic measure in pulmonary tuberculosis.

CONCLUSION

In properly selected cases of pulmonary tuberculosis with pregnancy as a complication, or relatively too profuse or frequent menstruation, particularly in the presence of traumatism from childbearing, or uterine hyperplasia, a panhysterectomy, with as a rule saving of the appendages if the patient is young, will remove a most serious handicap and give the patient the best possible opportunity to attain recovery from the primary disease.

[1] For full description of my technique see Am. J. Obst. 1917, lxxv No. 2.

BLOOD PRESSURE IN THE NEWBORN FOLLOWING NORMAL AND PATHOLOGICAL LABOR[1]

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From the Maternity of the Michael Reese Hospital

SINCE Vierordt (12) in 1894 first attempted to take blood-pressure readings in the newborn, considerable work has been done along this line by different investigators using various types of instruments. Neu (7), using the Gaertner tonometer, found the systolic blood pressure in normal newborn to be 90 millimeters mercury and Trumpp (11) estimated it between 60 and 90 millimeters. Oppenheimer and Bauchwitz (8) and Gundobin (3) found the average systolic pressure to be between 60 and 80 millimeters, using the Riva-Rocci instrument, while Popoff (9) found it to be between 40 and 70 millimeters with the same instrument. Seitz and Becker (10) more recently found the normal systolic pressure to be 43 millimeters on the first day, 60 at one week, and 70 at two weeks of age. Balard (1) obtained a maximum of 55 and a minimum of 35 on the first day by means of the Pachon oscillometer. Most of these readings were obtained from a few scattered cases, no attempt being made to follow either the blood pressure day by day, or the variations due to pathological labors.

According to Howell (4) and other physiologists, the blood pressure is produced by a combination of three factors: first, the force of the heart; second, the blood volume; and third, the peripheral resistance. It must necessarily follow that the blood pressure in newborn infants is low since all factors are especially low in the newborn. Seitz and Becker give the blood volume as one-nineteenth of the body weight whereas in the adult it is one-thirteenth. In the newborn the left heart is not fully developed, particularly in comparison with the right heart. The peripheral resistance is slight because of the lack of development of the elastic fibers and muscle coats of the arteries, as worked out by Fuchs (2) and also Jores (5).

In this investigation all types of deliveries were studied in order to determine, first, the daily blood pressure following normal deliveries; second, the effects of operative deliveries, and third, the influence of any other factors. Our one hundred cases therefore include 55 cases following normal spontaneous deliveries in normal gravidæ: 10 cases of low forceps, 6 cases of mid-plane forceps, 1 breech delivery, 6 cases of version and extraction, 1 face presentation, 2 cases delivered by abdominal cæsarean section, 2 premature infants, 6 sets of twins, and 5 cases showing unusual variations. When this work was undertaken, daily readings were made on every infant until there were as many on the list as could be accurately examined each evening. Thereafter additional newborn were added to replace the cases completed on the tenth day. This lists represents, therefore, neither 100 consecutive cases nor 100 picked cases which explains the presence of only one breech delivery as against 6 cases of version and extraction and 16 forceps deliveries.

TECHNIQUE

The blood-pressure readings here reported were all taken with a mercury manometer and an arm band 6 centimeters in width. At first the auscultatory method was tried but found to be too inaccurate. The palpatory method was then used as follows: All readings were taken immediately after the 6 o'clock evening feeding when the infants were quiet and dozing, no readings being taken while the infants were restless or crying. The cuff was applied to the left arm in every instance because it is a rule at the Michael Reese Maternity that every infant's identification tag must be sewed on the right wrist and this interfered with palpating the pulse on the right wrist. The cuff was then inflated with sufficient air to occlude the radial pulse. It was then allowed to fall gradually until the pulse reappeared, at which point the reading was taken as the systolic blood pressure. To

[1] Read before the Chicago Gynecological Society, February 16, 1923. (For discussion, see page 238.)

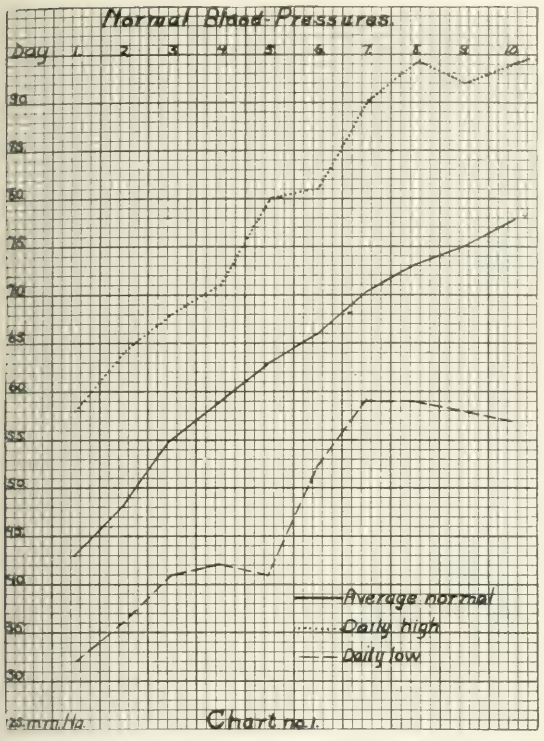

Chart 1. Blood-pressure readings in normal infants.

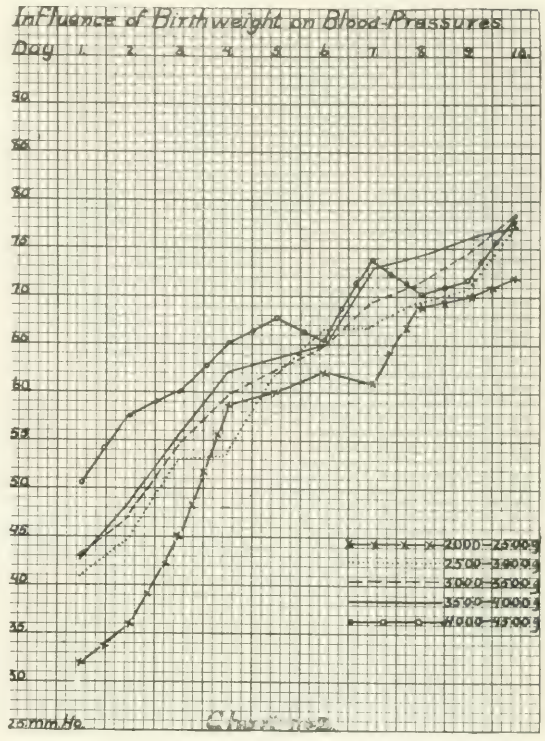

Chart 2. Relation of blood pressure and birth weight.

avoid possible errors, one of us inflated the cuff and noted the readings while the other felt the pulse, alternating every evening.

As a further check, every case showing an unusual reading was done by both of us. Four readings were taken in each case, each evening, and the average recorded. The one hundred newborn infants were followed through in this manner for the first 10 days of life. It was impossible to take readings over a longer period of time because normal patients are discharged on the eleventh day.

NORMAL CASES

We have found from a study of 55 cases that the average systolic blood pressure on the first day of life in newborn infants following normal spontaneous deliveries, is 43 millimeters mercury. The minimum reading found on the first day was 32 millimeters, obtained in a case weighing only 2300 grams at birth and following a pregnancy of 38 weeks. Later we will show that both prematurity and small size lower the blood pressure, but we felt that, with a prematurity of only 2 weeks, this case should be included among the normal cases. The maximum reading recorded on the first day was 58 millimeters in a primiparous baby weighing 4180 grams. Parity also influences the systolic pressure and this, together with the large size of this baby, readily explains the high readings.

TABLE I.—AVERAGE DAILY BLOOD-PRESSURE READINGS IN NORMAL NEWBORN

Day	1	2	3	4	5	6	7	8	9	10
Average	43	48	55	59	63	66	70	73	75	78
Daily high	58	64	68	71	80	81	90	91	92	94
Daily low	32	39	41	42	41	52	59	59	58	57

From Table I (see also Chart 1) it can be seen that there is a gradual daily increase in blood pressure, more marked during the first 3 days than later, until on the tenth day the average reading is 78 millimeters. Seitz and Becker in their four readings taken on the first day, obtained the same average of 43 millimeters and also found a more

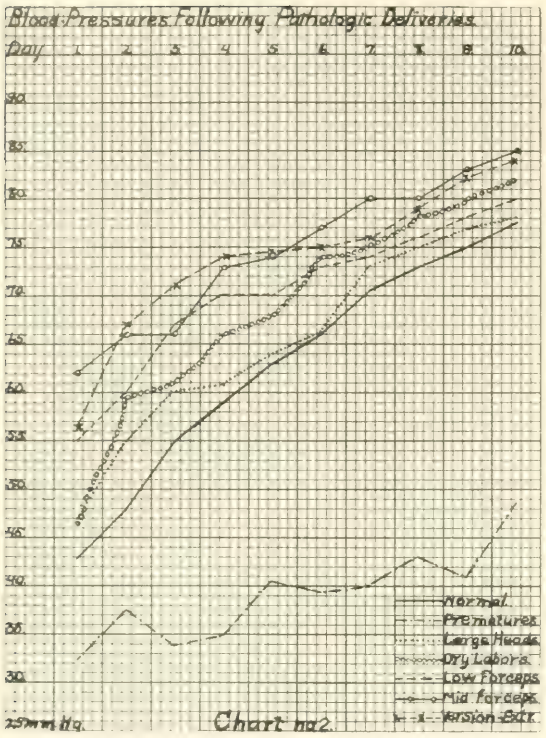

Chart 3. Blood pressure following pathological deliveries.

rapid rise during the first 3 days than later, their figures corresponding exactly with ours. After the first 3 days, however, our figures are higher, their 12 readings on the tenth day averaging only 66 millimeters.

FACTORS INFLUENCING BLOOD PRESSURE

Weight. If we classify our normal cases on the basis of birth weights, it will be seen that with the higher birth weights, the blood pressure is, in general, higher. This holds true not only for the first day but for the other days as well (see Chart 2). The average daily rise, however, is the same throughout.

TABLE II.—RELATION OF BLOOD PRESSURE TO BIRTH WEIGHT

Weight	Cases	1	2	3	4	5	6	7	8	9	10
[illegible]	1	32	36	45	50	60	62	61	69	70	72
[illegible]	3	41	43	50	51	65	67	68	68	71	70
2750–3000	6	41	47	50	56	60	66	66	71	72	77
[illegible]	7	42	46	52	58	61	63	68	71	73	80
3250–3500	13	44	49	57	60	64	68	71	72	76	77
3500–3750	9	42	46	54	58	63	63	68	71	73	73
3750–4000	6	43	51	57	66	64	67	78	78	80	81
4000–4250	4	51	58	58	62	63	68	72	74	75	81
[illegible]	1	56	58	60	68	72	68	75	64	68	75
4500–4750	2	56	60	63	63	64	68	73	73	83	84
[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]
[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]

The daily weight change does not influence the blood-pressure rise, the readings being higher day by day irrespective of the loss or gain in weight. It is also of interest to note that the greatest rise in blood pressure is during the first 3 days, during the time of the physiological loss in weight, and is apparently uninfluenced by it. This can be explained by the rapid increase in blood volume during the first 3 days of life on the basis of recent investigations of Mayers (6) and others. Mayers found the average erythrocyte count to be 7,630,000 per centimeter on the first day, after which it dropped to 6,100,000 by the fourth day and concludes that this drop is due to the fluid intake and a corresponding increase in blood volume.

Parity. Parity has very little effect upon the blood pressure, except that children of primiparæ with a long second stage of labor do show a slight increase over the normal during the first 4 days.

TABLE III.—RELATION OF BLOOD PRESSURE TO PARITY

Para	Cases	1	2	3	4	5	6	7	8	9	10
I	16	44	49	54	57	62	66	71	75	76	80
II	13	42	49	50	59	61	68	70	72	74	77
III	8	44	50	56	60	62	65	72	74	73	76
IV	3	43	49	52	62	69	69	74	75	77	78
V	6	44	50	56	59	62	66	66	70	76	81
VI	5	41	48	53	56	51	62	63	63	71	76
VII	2	39	48	62	62	66	63	74	73	74	75
VIII	1	40	43	58	65	60	63	63	62	70	78
IX	1	40	43	48	64	61	64	80	80	82	79

TABLE IV.—RELATION OF LENGTH OF SECOND STAGE

	Cases	1	2	3	4	5	6	7	8	9	10
Under 30 min.	9	43	47	55	60	60	65	71	72	77	76
30 min to 1 hr.	17	44	49	56	60	63	66	72	78	79	78
1 hr. to 1 hr. 30 min.	7	44	48	53	59	63	67	70	74	75	77
1 hr. 30 mn. to 2 hr.	10	43	47	55	59	63	65	69	73	74	78
2 hr to 2 hr 30 min	8	41	48	55	58	63	66	70	74	74	79
2 hr 30 min to 3 hr.	4	44	54	59	62	67	69	71	72	77	80
3 hr to 3 hr. 30 min	1	38	44	51	64	58	62	67	69	74	87

In Table IV, the highest blood pressures occur in those cases with a second stage of labor between 2 hours and 30 minutes and 3 hours. The lowest pressures, however, are found in cases with a second stage lasting from 1 hour and 30 minutes to 2 hours.

Cephalic measurements. The 12 cases having the largest cephalic measurements showed an average blood pressure higher than the normal especially during the first, second, and third days. Nine of these were large infants with heavy birth weights, which probably was a factor in the increase, but we believe birth trauma increases the blood

pressure and some of this increase is due to the added trauma which a large fetal head receives. This will be better shown in connection with infants delivered by operative procedures. The blood-pressure readings of the 12 cases average as shown in Table V.

TABLE V.—LARGE CEPHALIC MEASUREMENT

Day	Blood pressure
First	47
Second	55
Third	60
Fourth	61
Fifth	64
Sixth	66
Seventh	70
Eighth	75
Ninth	77
Tenth	78

The greatest increase, it will be seen, is during the first 3 days, after which the readings tend to approach the normal (see Chart 3).

Relatively dry labors. In the series of 55 normal cases, there were 14 in which the membranes had ruptured more than 2 hours before delivery. The blood pressures of these cases were averaged separately in order to determine what effect, if any, may follow the increased pressure on the head which occurs in relatively dry labors. Table VI and Chart 3 show that there is a definite increase in arterial tension above the normal most marked during the first 3 days. This is, of course, the period immediately following the trauma, and we believe that this increase in blood pressure is a direct result of the undue pressure exerted upon the head where there is no forelying bag of waters to act as dilator.

TABLE VI.—RELATIVELY DRY DELIVERY

Day	Blood pressure
First	46
Second	60
Third	61
Fourth	66
Fifth	68
Sixth	74
Seventh	76
Eighth	79
Ninth	80
Tenth	83

Caput succedaneum. The blood-pressure readings of 16 cases showing the formation of a caput succedaneum were also averaged separately and the average was found to be practically the same as that of the whole series of normal cases. It must be concluded, therefore, that the formation of a caput does not produce any increase in intracranial pressure that is demonstrable by a change in systolic blood pressure.

Other factors. Sex, the presence or absence of jaundice and temperature, and the pulse rate have no influence upon blood pressure. Balard (1) found that the newborn of toxic mothers had high blood-pressure readings. In our cases this was not found. We had 3 cases of definitely toxic mothers, showing high blood pressure, albuminuria and many casts but the blood-pressure readings in their infants were normal. The cases were also grouped according to the maternal blood pressures, but we could find no relationship between the maternal pressures and those of their newborn infants. The production of cephalahæmatoma has been attributed to high arterial pressure; in our cases this is not true, the readings being normal.

PATHOLOGICAL DELIVERIES

Low forceps cases. Infants delivered by low forceps show a distinct elevation in blood pressure. There were 10 such cases and by studying their average blood-pressure readings, it can be seen that this elevation persists throughout the first 10 days. This increase is apparent immediately on the first day at which time it is the highest, remaining so for the first 4 days (see Table VII and Chart 3.)

TABLE VII.—LOW FORCEPS CASES

Day	Blood pressure
First	55
Second	60
Third	67
Fourth	70
Fifth	70
Sixth	73
Seventh	74
Eighth	76
Ninth	78
Tenth	81

During these 4 days the average is 12 millimeters higher than the normal average. On the fifth and sixth days the increase above the normal is only 7 millimeters and during the last 4 days it gradually diminishes until, by the tenth day, the blood-pressure readings are 3 millimeters above normal.

Midplane forceps cases. Blood-pressure readings in infants delivered by midplane forceps show an even more marked increase above the normal than do the low forceps cases. Our 6 cases had an average blood pressure on the first and second days of 62 and 66 millimeters respectively, or 19 millimeters above those delivered spontaneously. From the third to the seventh days the blood pressures were 11 millimeters above normal and during the last 3 days 7 millimeters above the normal. It should be noted that, in both low and midplane forceps cases, the greatest increase above the normal is again during the first 3 days (see Table VIII and Chart 3.)

TABLE VIII.—MIDPLANE FORCEPS CASES

Day	Blood pressure
First	62
Second	66
Third	66
Fourth	73
Fifth	74
Sixth	77
Seventh	80
Eighth	80
Ninth	83
Tenth	85

Version and breech extraction. Six cases delivered by version and breech extraction showed an increased blood pressure throughout, being especially marked on the second, third and fourth days, during which period it was 15 to 18 millimeters above normal. The increase on the first day was 13 millimeters (see Table IX) and on the fourth and fifth

TABLE IX.—VERSION AND EXTRACTION CASES

Day	Blood pressure
First	56
Second	67
Third	71
Fourth	74
Fifth	74
Sixth	75
Seventh	76
Eighth	79
Ninth	83
Tenth	84

days, 10 millimeters. After the sixth day the increase was only 6 millimeters. There was one case of spontaneous breech delivery in which the blood-pressure readings were normal.

Cæsarean section cases. Two cases delivered by abdominal cæsarean section showed normal blood-pressure readings.

Face presentation. One case delivered spontaneously as a face presentation. Here also the blood-pressure readings were normal.

Prematurity. In premature infants the blood pressure is markedly lower and remains low throughout the 10 days. The more marked the prematurity, the lower the blood pressure. It should be noted that, in the 7 months premature infant, there is practically

TABLE X.—PREMATURE INFANTS

	Day	1	2	3	4	5	6	7	8	9	10
8 mos	Premature	35	34	37	34	41	42	44	47	46	60
7 mos	Premature	30	41	31	36	40	37	30	39	36	36

no rise during the first 10 days, the blood pressure remaining stationary. (Table X.) These low readings are probably due to immaturity of the circulatory apparatus. The 8 months premature infant weighed 2000 grams at birth. There was also one full-term normal infant with practically the same birth weight, and in this latter case the blood pressure, while low the first day (32 millimeters) rose daily as in other full-term infants.

Multiple pregnancies. There were 6 cases of twin pregnancies, all but Case 6 being born 2 to 4 weeks before their estimated dates. These ten babies, therefore, were all premature infants of low birth weights and, as might be expected, showed low blood-pressure readings in spite of operative deliveries. Twins No. 6 were of unusual interest. They were carried to term and when born, weighed 3970 and 2430 grams respectively. Both were delivered by breech extraction, the heavier one being the first to be delivered. The blood-pressure readings of this heavier twin correspond to our readings for breech extraction. The second twin was of average weight,

TABLE XI.—MULTIPLE PREGNANCIES

No.	Lgth. Gest.	Par.	Sex	Wt.	Delivery	1	2	3	4	5	6	7	8	9	10
1	35wks	1	m	2580	High forceps	32	37	40	43	51	51	57	63	62	69
			m	2370	Version-ext.	34	40	43	45	49	47	55	51	58	68
2	35wks	5	f	2600	Breech ext.	34	42	43	53	52	54	52	67	65	62
			f	2200	Breech-ext.	32	31	41	47	50	53	49	64	62	59
3	36wks	1	m	2260	High forceps	36	51	58	61	58	57	66	64	63	72
			m	2030	Version-ext.	42	43	42	40	59	62	62	67	61	58
4	38wks	6	m	2840	Spont.ROA	40	47	62	65	69	68	73	69	73	78
			m	2340	Spont.ROA	38	41	61	61	64	63	71	68	72	76
5	38wks	1	f	2190	Breech-ext.	42	45	57	74	67	71	69	67	68	77
			f	1870	Breech-ext.	44	44	56	70	68	68	66	66	66	74
6	term	2	m	3970	Version ext	61	67	71	80	85	86	88	87	90	86
			m	2430	Version ext	42	52	50	67	66	68	69	73	70	75

i.e., of the other twins and showed blood-pressure readings comparable to the readings found in other twins. It would seem that the low readings obtained in twins are due to prematurity and low birth weight rather than to the fact of twin pregnancy itself.

Certain cases in which there was definite clinical evidence of cerebral injury or in which the fetal head had been subjected to the trauma of prolonged and difficult labor, bring out most clearly the conclusion that such trauma causes an increased systolic blood pressure. Furthermore, with clinical improvement, the blood-pressure readings gradually approached the normal.

Case 64. Para-II, male child, birth weight 3220 grams. Presentation was a right brow anterior with no progress after 3 hours in the second stage. Podalic version and breech extraction was done and considerable difficulty encountered in delivering the aftercoming head. The pressure on the first day was 58 and the pulse 108, which was unusually low. On the second day the pressure was 68 and the pulse 100. There was a typical cerebral cry, bulging fontanelle, marked overriding of the bones of the skull, rigidity of the neck and extremities, opisthotonus, a nystagmus and increased reflexes. A spinal puncture was done and spinal fluid obtained under pressure, 8 cubic centimeters being removed. The third day the pressure was 70, the pulse still 100 and the general condition about the same. Another spinal puncture was done and 6 cubic centimeters of spinal fluid removed. The fourth day there was a slight clinical improvement and the pressure was 83, the pulse having increased in rate to 128. The child gradually recovered and as improvement set in, the blood pressure stopped rising rapidly, being 76, 76, 78, 82, 82, and 84 for the remaining days.

Case 60. Para-V, male child, birth weight 2720 grams, spontaneous right occipito-anterior with a second stage of 15 minutes. On the fourth day this case had a temperature of 101° and a pulse of 120 and suddenly became cyanotic and had a generalized convulsion lasting 5 minutes. Following this, the systolic pressure was 76 and remained that high for the following 5 days.

Case 80. Para-II, male child, birth weight 3280 grams. This was a persistent right occipito-posterior for 5 hours. Spontaneous delivery occurred while preparations were being made to perform a rotation and extraction. The blood pressure in this case was very high throughout the 10 days, being 61, 64, 72, 75, 77, 82, 90, 78, 82, 83, and 79.

Case 67. Para-II, male child, birth weight 3020 grams. The head was on the perineum for 1 hour and 30 minutes. The blood pressure on the first day was 62. Child had a typical cerebral cry and a slight rigidity of the neck. There was a loud systolic murmur replacing the first tone at the apex. On the second day the child suddenly became cyanotic and died. Unfortunately no postmortem examination was permitted.

CONCLUSIONS

1. The average systolic blood pressure during the first day of life in full-term infants, following normal spontaneous labor, is 43 millimeters mercury.

2. The blood pressure increases daily until, on the tenth day of life, the average systolic blood pressure is 78 millimeters.

3. The greatest rise is during the first 3 days, reaching 59 millimeters on the fourth day.

4. The blood pressure varies with the birth weight, being higher in heavier infants.

5. Sex, jaundice, pulse rate, and temperature and caput succedaneum with no signs of compression apparently have no influence on the blood pressure.

6. Infants delivered by abdominal cæsarean section have normal blood pressures.

7. Premature infants have low systolic blood pressures corresponding to the length of gestation.

8. Twins have low blood-pressure readings proportional to the prematurity and the birth weight.

9. The greatest increase in blood pressure is shown after midplane forceps extraction and version extraction; lesser increases were shown after low forceps extractions, relatively dry labors, prolonged second stages and in infants with large cephalic measurements.

10. The increased blood pressures found seem to be due directly to increased trauma to the fetal head.

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CHOLECYSTECTOMY WITHOUT DRAINAGE

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INSPIRED somewhat by reading the articles of Willis and Richter as to the closing of the abdominal wound without drainage after doing a cholecystectomy, and encouraged somewhat by my own convictions in the matter, it seemed to me that such a procedure would be good surgery in certain selected cases. During the past 2 years I have closed practically every abdomen from which the gall bladder was removed without the aid of any drainage whatsoever.

It appeared to me that if it is good practice to close the abdomen without drainage after an appendectomy, it should be good practice to follow the same principle after a cholecystectomy. In my estimation there are three factors that make one hesitate in doing this: (1) The question of infection; (2) The question of spilling of bile; (3) The question of the bile pressure that might occur in the remaining cystic duct.

As to infection, it is true that we do not hesitate to close many pelvic cases that are known to be infected and in which there is still pus about the peritoneum. We also do not hesitate to close without putting in abdominal drainage many cases of bowel anastomosis, in which there must be more or less liability to spread infection. Then there are many cases of appendectomy, in which the peritoneum has actually become soiled with possible sources of infection and in which we close the abdomen and the patients do very well. So, why should we worry particularly about infection from the gall-bladder region? If the gall-bladder operation is done with the same precaution as that of the appendix, i.e., as regards the spilling of bile contents, etc., I do not believe that the question of spread of infection in this type of case needs to be a factor in our ordinary operative routine. It must be admitted, however, that there are certain cases of bowel anastomosis and also certain cases of appendicitis that are operated upon, in which it is absolutely imperative to insert drainage. This holds true to some extent in the gall-bladder area: (1) ruptured gall bladders, (2) empyema of gall bladder.

I feel quite sure that it is the experience of all of us that drainage anywhere in the abdomen is apt to invite infection quite as much as it is apt to prevent the spread of infection.

As regards the spilling of bile, I do not think that there is one of us who has done gall-bladder surgery who has not at some time or other spilled large quantities of bile into the abdominal cavity, and we have depended more or less on packing to take care of this spillage. In these cases the bile is protected from the intestine but does, to some extent, drain down into the right flank, particularly outside of the cæcum. It is almost impossible with packing to take care of this leakage. It is almost impossible to wipe this material out. We have all observed that when we do insert drainage in these cases to take care of the spilling of bile that the wound really does not drain any bile but does drain large amounts of serum. The bile must then have gravitated down into the right flank, and there the peritoneum has taken care of it.

As regards pressure in the common and cystic ducts, it has been shown that this pressure amounts to only 200 to 500 millimeters of water, which is very much less than the arterial blood pressure of the average individual. We tie with catgut a large blood vessel where the pressure is much greater than we find in the common duct, and still we do not necessarily insert drainage to take care of any possible slipping of the ligature when we tie a blood vessel, but heretofore we have thought it necessary to do such a thing when we tie the cystic duct.

The outstanding complications and postoperative difficulties which have urged me to adopt this method are:

1. *Pain.* The fact that the large majority of our patients with drainage tubes inserted

down to the region of the stump of the gall bladder complain of a great deal of post-operative pain, especially during the first 48 to 72 hours. This pain always radiates up into the shoulder, and is very characteristic, resembling very much the ordinary pain experienced in gall-bladder colic.

2. *Tympany.* Many of these patients complained considerably of tympany and had nausea and vomiting after operation.

3. *Drainage.* The question of drainage itself. These wounds often drain for a long time, making the convalescence in the hospital much longer than it should be; in fact, we have sent home many patients who were draining more or less bile or seropurulent material from the wound. This has delayed the convalescence very materially.

4. *Temperature and pulse.* Many of these patients have had a marked rise in temperature and an increased pulse rate the first 2 or 3 days after operation, which always gave more or less concern.

5. *Source of infection.* Although the drainage tube was removed in 24 to 48 hours in many of these cases and although the wound apparently was normal, with no drainage of bile or pus, still in 2 or 3 days after removal of the tube pus began to come from the wound, indicating that possibly the infection came from without rather than from within.

6. *Postoperative results.* A great many of these patients in whom drainage has been used, for a long time afterward, complain of more or less pain in the region of the gall-bladder area, associated with symptoms of more or less gastric distress, undoubtedly due to adhesions. Willis has demonstrated experimentally and otherwise that when drainage is used and particularly when bile drains from the wound, adhesions are apt to form and that these adhesions are very dense in character. This in itself should speak against the use of drainage in these cases.

7. *Postoperative hernia.* Although postoperative hernia is not a common incident, the danger of its occurrence is much greater when drainage is used than when the wound is closed without drainage.

A review of the literature shows that as far back as 1905, Witzel reported 500 cases in which he closed the peritoneum without drainage. However, he describes in much detail, the closing in of the cystic duct. About the same time, Robson and Moynihan also advocated, or at least suggested, that in certain cases it might be advisable to close the abdomen without drainage. Most of the literature in this country comes from the clinics of Richter and Willis and from Richter's former pupil, Buchbinder. Richter, of Chicago, was probably more or less of a pioneer in this work in this country. He reported his cases in 1916, and Willis reported his series in 1917, since which time both of them have again reappeared in print with more data, and a very much larger series of cases.

The technique for removal of the gall bladder used by these men has varied considerably. Witzel started out by doing a Lambert over the cystic duct. One author ties the duct by making a cuff of the mucous membrane and then tying the duct and allowing the mucous membrane to fall back over the cut end. Another author carbolizes the end of the stump. Still another operator puts a double ligature about the cystic duct and buries it back of the peritoneal surface covering the liver. One of the more recent writers becomes still more bold and just simply ties the duct with a plain No. 0 or No. 1 catgut and drops it back in the wound. This is similar to the method by which Morris removes the appendix. Some prefer to remove the gall bladder from above downward, and some from below upward. It is probably largely a matter of choice in their own particular method.

It has been my practice to remove the gall bladder from below upward. I expose the gall-bladder region by a modified curved incision, so as to bring the liver out as well as possible. With the Mayo scissors I separate the peritoneal covering over the cystic duct, and dissect out the duct itself so that it stands out and is seen very distinctly. It is quite important that none of the loose connective tissue is included in the dissection. The duct itself must be clearly found and isolated. I clamp both the distal and proximal ends, placing the two clamps as near together as possible, and cut between the

clamps so as to lessen the spilling of bile contents or infection. I then isolate the cystic artery and tie. By cutting the peritoneal reflection across the gall bladder so as to leave a flap on each side where the bed of the gall bladder would naturally be after removal, and by dissecting from below upward, I remove the gall bladder by blunt dissection or scissors. I have, then, in my desire to be as safe as possible, ligated the cystic duct in two separate places with a formalized No. 0 or No. 1 catgut. On account of the depth of the wound, one must be very careful to see that the ligature is tied very tightly. When one is sure of the ligation the common duct may be dropped back into the wound. The artery is ligated separately. A running catgut stitch is made, starting from below and running upward, catching the layer of peritoneum that has been reflected backward, so as to leave a running closed peritoneal surface on the inner side of the liver. It is needless to say, of course, that before removing the gall bladder, it is very essential to hold back with moist gauze, the intestine, the stomach, and duodenum so as to have a good field. I have found that if present, oozing from the liver surface after removal of the gall bladder is easily controlled by the application of hot packs. The wound is then closed tightly.

I do not mean to infer that in every case in which the gall bladder is removed the wound should be closed without drainage; for instance, in one case during the past year, in which there was a ruptured gall bladder, I inserted drainage, although in this particular case I feel confident now that I would have been perfectly safe had I closed without drainage. I would, however, drain (1) when bleeding cannot be controlled, (2) when empyema of the gall bladder is present, and (3) when, for some reason, it is necessary to insert drainage into the common duct, as occurred in two of our cases.

I have reviewed the cases occurring in my service during the years 1920, 1921, and 1922, and find that I have done a total of 80 gall-bladder removals during this time; 50 of these cases have been closed without drainage and 30 with drainage. Most of those with drainage were done during the year 1920. I have attempted in this study to bring out some comparative statistics, and although I had my own convictions before the statistics were made, they do confirm the opinion that I previously held.

Temperature. Taking the highest temperature point within the first 4 days after operation, we found that of a total of 30 cases with drainage, 8 had a temperature of 99°; 5 a temperature of 101°; 1 a temperature of 102°; 2, of 103°; 1, of 105°. In those cases without drainage, 16 had a temperature of 99°; 3 a temperature of 101°; 5 a temperature of 102°; 1 a temperature of 103°. However, in those cases with a temperature of 102° or more, 3 of them developed postoperative pneumonia, and 2 postoperative bronchitis.

Tympany. We find that tympany after operation in the cases with drainage was present in 18, absent in 10. In those cases without drainage, 6 had tympany, and 42 none.

Pain. I have classified postoperative pain into three types: those with (a) no pain, (b) slight pain, and (c) severe pain. Of those with drainage, 4 had no pain, and 26 had pain. The proportion of definite statistics as regards postoperative pain is not very clear in the records for 1920. In those cases that were closed without drainage, 33 of them showed no pain, 13 slight pain, and 4 severe pain, postoperatively. In the number of those with drainage, the pain was very much more severe the first 2 or 3 days.

Stay in the hospital. We found that the average duration of the patient's stay in the hospital was 14 days, when drainage had been used, while it was 12 days, when drainage was not used. However, in 1921, in the cases without drainage, there were two patients that developed postoperative pneumonia, which delayed their convalescence, and one patient, who lived out of the city, did not wish to go home for various reasons. In three cases the convalescence was markedly delayed on account of the fact that we really did too much surgery, i.e., we did several operations on different parts of the body at the same time. This runs the average stay in the hospital up slightly, but I am positive that

the average is at least 3 or 4 days less in the uncomplicated case when no drainage is inserted.

Follow-up record. In the follow-up record of the 1921 patients (those without drainage), I find that 15 patients report as feeling fine; no report is given for 3 cases; 1 case reports no relief. Unfortunately, the 1920 cases were not so complete as to their summaries. In those cases in 1921 that can be reported without drainage, 17 cases made an absolutely uneventful convalescence. However, pneumonia developed in 2 cases, and 3 cases were pregnant at the time of operation. The 1922 follow-up report is not completed.

Mortality. There were only four deaths in the entire series, all drainage cases, but this is largely a coincidence. The first death occurred on the third day after operation from a streptococcus infection, proven by autopsy. There was absolutely no leak from the bile passages, nor from the appendix (which was removed at the same time), but it was proven that the infection came from an outside source. The second death was due to acute dilatation of the stomach 48 hours after operation; the third to massive collapse of the lung on the fifth day; the fourth to peritonitis and anuria on the eighth day.

From this review of our cases, as well as from my own personal contact with the patients, I can recommend that in practically every case of cholecystectomy it is possible, if the technique is properly carried out, to close the gall-bladder incision without drainage. If this is done, I feel certain that the postoperative pain, especially that passing up into the shoulder blade and scapula, the postoperative nausea and vomiting, the postoperative temperature, the postoperative tympany, and finally the entire convalescence, will be very much smoother and more pleasant to the patient, and to the surgeon, and that the end-result will be far more gratifying in all respects.

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DEPARTMENT OF TECHNIQUE

A TECHNIQUE FOR THE RESECTION OF GASTRIC AND DUODENAL ULCERS[1]

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WHILE the debate as to the relative merits of medical or surgical treatment in cases of duodenal ulcer continues apparently interminably, no such condition regarding similar lesions of the stomach obtains. The potential malignancy of gastric ulcer makes such a lesion at all times dangerous, and leaves small room for favorable argument from even the most enthusiastic supporters of medical treatment. The physical differences between the benign and malignant gastric ulcers are so few, and indeed so often absent in smaller lesions, that sometimes even the most experienced surgeon, with the lesion under eye and touch, is unable to differentiate the two accurately. Aschoff believes that if the original lesion is carcinoma, the base of the ulcer shows carcinomatous changes. Wilson and MacCarty have shown that the carcinomatous degeneration can be demonstrated in the overhanging edges of the ulcer, but not in the base. It is then an obvious corollary that a gastric ulcer should be subjected to surgery. The frequency with which penetration of the serous coat of the stomach occurs in these lesions, making possible an attachment to a neighboring viscus, places many difficulties in the way of the surgeon. Often these obstacles are wellnigh insurmountable within a reasonable margin of safety, and for that reason no fixed procedure is applicable to all cases. That the cautery method of Balfour is admirable for many ulcers of this perforating type has been demonstrated so often that its value is unquestionable. Resection of the entire ulcer with a cautery by cutting through normal mucosa has some adherents despite the fact that this removal cannot be carried out without considerable soiling and often a resulting deformity of the stomach, which is closed with difficulty.

Most gastric ulcers are located on the lesser curvature of the stomach in its middle third. Three-fourths of all the hard, calloused ulcers of the posterior wall, which form the most difficult group to attack by any procedure, are located in this middle third. In order to remove these ulcers for microscopic study and at the same time to be radical enough in case the lesion is malignant, the ideal technique requires ready mobilization of the ulcer area and a secondary closure which prevents contamination so far as possible, and at the same time leaves the parts free from deformity. Usually gastric ulcers which are adherent are attached firmly to the pancreas, but sometimes this perforation is found to be fixed to the liver, or the round ligament, or occasionally to the peritoneum of the abdominal wall. It is advantageous to remove this, preferably intact, in mobilizing the stomach, so that no open perforation will occur, permitting the escape of gastric contents and the spread of contamination in the peritoneal cavity.

A study of the cases of gastric ulcer at the Mayo Clinic with especial reference to their end-results and the type of operation employed has demonstrated that approximately one-third of the patients with gastric ulcer on whom resection was performed without gastro-enterostomy failed to obtain entirely satisfactory results, while a similar percentage of patients on whom gastro-enterostomy was performed, but without excision of the local lesion, had likewise obtained only partial relief, or their symptoms had not abated. Such experience makes it seem advisable to supplement excision of the gastric ulcer with gastro-enterostomy, a procedure which has been followed in all but a few cases operated on recently. In cases of duodenal ulcer, the question of malignancy does not arise, and consequently treatment by medical methods is not inadvisable in many cases.

The belief that a direct attack on the pathological condition present which is causing the symptoms is the feasible procedure in cases of ulcer of the duodenum, provided it can be accomplished without increased mortality resulting from the operation, led to our undertaking a series of excisions of ulcer without gastro-

[1] Submitted for publication April 5, 1923.

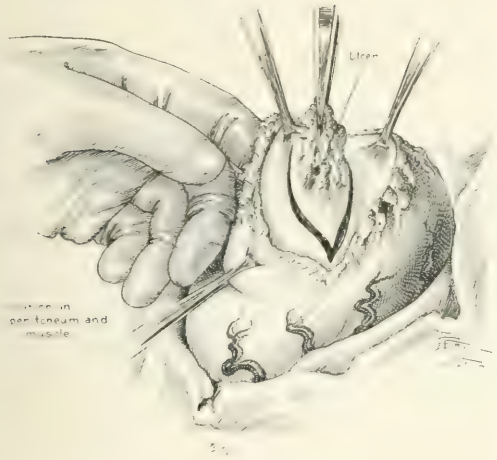

Fig. 1. Ulcer area outlined by incision.

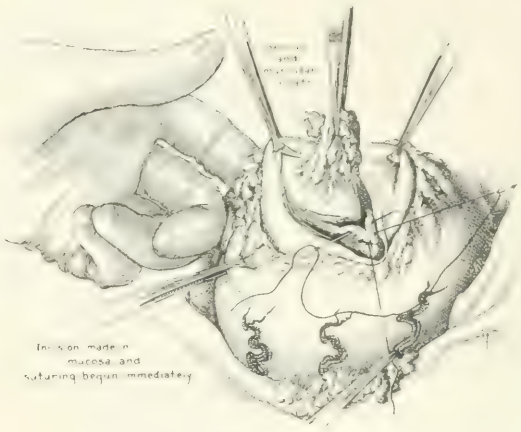

Fig. 2. Opening in mucosa and suturing of mucosa.

enterostomy, and the end-results have prompted the continuance of this method. In the light of the present knowledge of the cause of gastric and duodenal ulcers, it is logical to remove the offending lesion together with the foci of infection, rather than to trust to a side-tracking procedure which leaves a pathological entity in which healing is a moot question and in which exacerbation gives rise to a chain of symptoms similar to those for which the patient first sought relief. It should be recognized that no one method is adaptable to all cases, and that resection of duodenal ulcers should be carried out only in cases in which location and attachment permit mobilization without more risk than other recognized methods of surgical treatment.

It is estimated that about 2 to 4 per cent of gastro-enterostomized patients develop jejunal ulcers at, or near, the line of anastomosis. That this is an unfortunate sequela which is most difficult to remedy, even the most optimistic cannot deny. In a case presenting this unfortunate complication, nothing short of a radical operation fraught with many technical difficulties is worth considering, and one of the facts experience has established is that a second gastro-enterostomy following the resection of a jejunal ulcer is not well tolerated. It is then necessary to resect the primary ulcer and to apply a plastic procedure to the pylorus. Primary resection without gastro-enterostomy avoids this small percentage of cases and renders unnecessary the second formidable operation. To push any operation beyond its limits is to bring it into disrepute, and necessarily before electing to make a resection, mobilization without too much trauma and without sacrifice of too much of the blood supply, must be feasible. Finney, in his pyloroplasty has demonstrated that one is able to cut off much more of the blood supply than was formerly thought safe. The anterior duodenal vessels may be sacrificed freely and much of the supply from the pancreaticoduodenal artery may be tied off without causing damage.

An added advantage of excision with a knife is that it permits an inspection of the upper portions of the duodenum. While the greater number of duodenal ulcers occur on the anterior surface nearer the upper border, it is surprising how often unsuspected lesions are encountered on the mucosa of the posterior wall. These so-called contact ulcers are present in a fairly large percentage of cases, and the operative technique must be modified to include their destruction or extirpation. Perforation results more often in an attachment to the head of the pancreas than to any other viscus, and, when it occurs, accentuates the operative difficulties. If the ulcer is of long standing and is hard, firm, and calloused, causing sufficient pyloric stenosis to produce gastric dilatation, the simple excision is amplified by a modified pyloroplasty with gratifying results. We have found the addition of the Rammstedt technique of simply incising the muscle fibers of the pyloric ring at right angles to the opening, to be of advantage. Gastro-enterostomy to complete this operation has not been found necessary in cases of duodenal ulcer. The postoperative course of these patients has been remarkably smooth and free from such unpleasant complications as gastric retention. The end-results which have been tabulated from letters received after

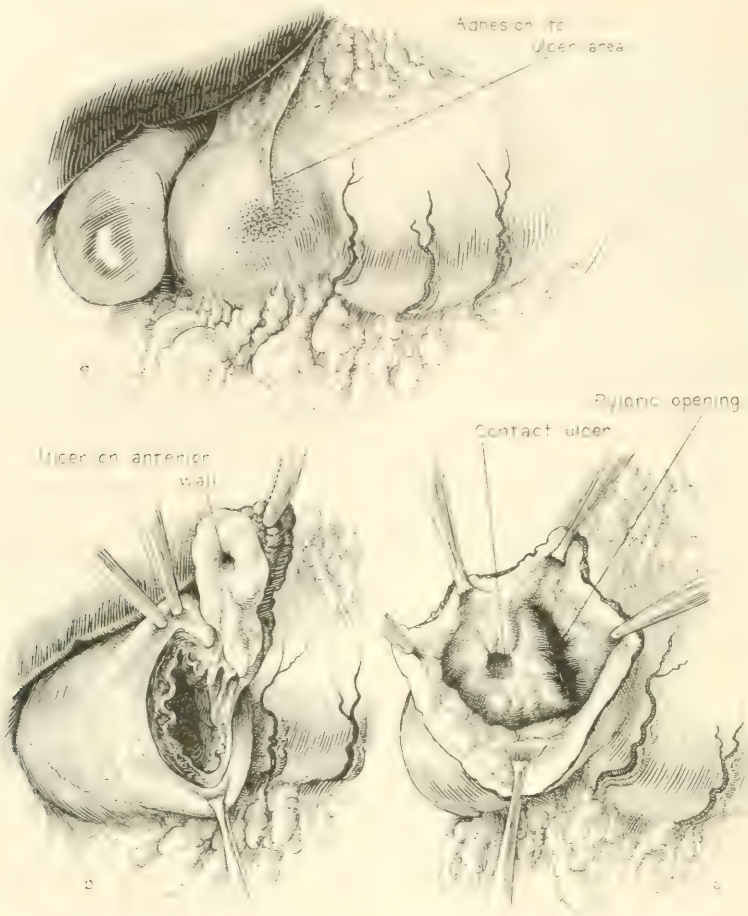

Fig. 3. *a*, Stippling at ulcer site. *b*, Ulcer on anterior duodenal wall excised. *c*, Ulcer on posterior wall exposed.

operation have been so satisfactory as to warrant the use of the technique in a larger series of cases.

It would seem that the ideal indication for resection of a duodenal ulcer would be met in the patient whose most distressing symptom has been bleeding, and indeed we have employed it in every case of this type when it was possible to remove the offending lesion without performing what seemed to be a too extensive operation. Many patients, however, who complain of bleeding have been obese and exsanguinated to such an extent that any formidable operation was considered unsafe. Very often, also, the local condition has been found to be a perforating type of lesion so remote from the operative field that its removal by accurate operative technique seemed impossible. Thus, one must be content to ligate the afferent vessels that are within reach and to perform a posterior gastro-enterostomy, or destroy the ulcer with a cautery and complete the operation in the same manner. When localized pain in the upper right quadrant of the abdomen has been the predominant symptom, it has seemed wise to excise the duodenal ulcer in all cases possible without the addition of a jejunal anastomosis. Urging the necessity of proper selection of suitable cases of duodenal ulcer for a resection without gastro-enterostomy, we feel sure that a proper use of the technique of excision, as described here, will warrant its wider application. In cases of gastric ulcer the ease and accuracy of removal and the freedom from soiling, as well as the absence of deformity in the finished result, has prompted the adoption of this technique in a large series of cases, the end-results of which have been entirely satisfactory.

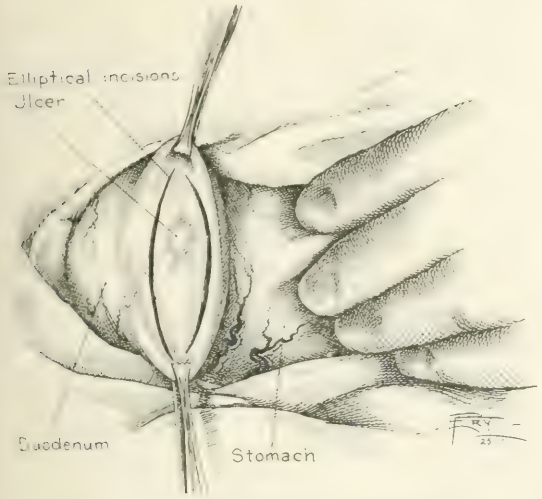

Fig. 4. Two elliptical incisions around ulcer.

OPERATIVE TECHNIQUE

Gastric ulcers. Adequate exposure through an ample working incision is a cardinal principle in rall plastic surgery, and a modification of the high bight-rectus incision popularized by Bevan has been found to be the one of choice. This incision begins at the xyphoid cartilage and extends obliquely downward and outward to a point 1 inch opposite the umbilicus. The round ligament of the liver, which is now known to have no function of suspension, is divided between clamps and may be reunited by ligature or suture at the end of the operation. It is essential to ligate both cut ends of the ligament because of subsequent hæmorrhage which may occur from the small vessel which accompanies it. This step increases the exposure markedly because the proximal end of the ligament may be used as a retractor to draw the overhanging left lobe of the liver out of the operative field. Mobilization of the stomach by separating the attachments to neighboring organs can be made either by approach from above, through the gastrohepatic omentum, or from below, through the transverse mesocolon; the approach from above downward is generally preferable.

By dividing the gastrohepatic omentum and ligating the gastric artery on both sides of the ulcer with the surrounding inflammatory mass, the site of attack is brought into the operative field by traction on the stomach by an assistant. Having freed the mass from its attachment by sharp dissection, the raw surface of the pancreas or liver is sutured over with catgut. This is advantageous in preventing subsequent adhesions

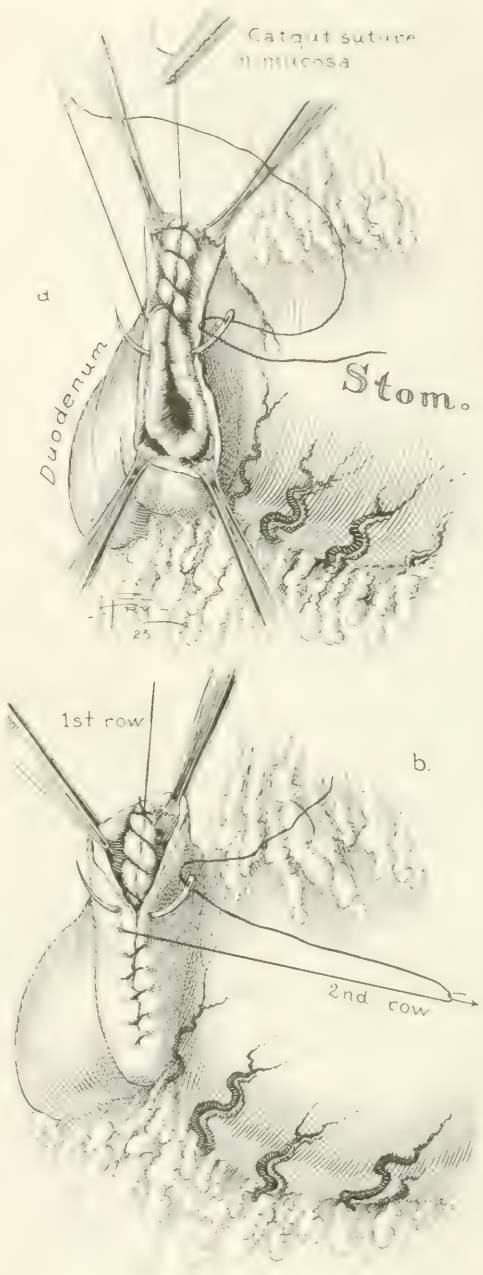

Fig. 5. *a*, Suturing mucosa separately. *b*, Suturing muscle and peritoneum.

and consequent deformity. The operative field is caught with an Allis forceps on the posterior wall, and an assistant holds the anterior wall of the stomach directly opposite. A circular incision

Fig. 6. Rammstedt addition used where the pyloric muscle is tense.

through the serous coat outlines the amount of tissue to be sacrificed. The incision is then carried down through the muscular coat to the mucosa, care being taken not to open the mucous membrane until the entire dissection is complete. Having completed this part of the operation, a small opening in the mucosa is made at the lowest point on the anterior gastric wall, and here the suture of chronic catgut is started immediately. The operator with one finger posterior to the mucosa controls the escape of any gastric contents simply by pressing the two walls of the stomach together at the opening. As the incision is carried higher and higher in the mucosa on both margins of the opening, the suture is continued so that the opening is closed as soon as it is made, and there is little or no contamination from leakage of gastric contents (Figs. 1 and 2). Another layer of catgut suture inverts the muscular and serous coats, and a few interrupted silk sutures, which take off any possible tension from the catgut line, are placed over the entire area of resection. The gastrohepatic omentum, or any adjacent fat tags which are available, are sutured down over the operative site. An all catgut gastro-enterostomy is made at the most dependent portion of the stomach on its posterior walls. The advantages of controlling hæmorrhage by direct suture of mucous membranes and of preventing soiling by suturing the opening as soon as it is made, are obvious. The difficulty of producing a large opening in the stomach which cannot be closed easily and accurately without considerable deformity is also obviated.

Duodenal ulcer. The duodenum is exposed by the same kind of abdominal incision as in resection of gastric ulcers. Its mobilization is accomplished by dividing bands of adhesions to neighboring organs and by ligating whatever blood supply on its anterior border is necessary. Partial ligation of branches of the pancreaticoduodenal vessel may be made without harm. By delivering the pyloric half of the stomach on the anterior abdominal wall and making slight traction on it, the exposure is increased. The duodenum is caught on the distal side of the ulcer with Allis clamps and steadied by an assistant. The ulcer is excised by being included in two semilunar incisions, the ends of which join. The upper incision is placed so that its middle lies opposite the center of the pyloric ring with its convexity upward; the lower incision is similarly placed, but with its concavity upward. These incisions encircle the ulcer and outline the amount of bowel to be sacrificed. They extend merely through the peritoneal coat. When this step has been carried out, the lumen of the duodenum is opened by extending the incision through its muscularis and mucosa. Any bleeding vessels are caught, as the incision is extended, and ligated with fine catgut. At this point in the operation, inspection very often reveals another ulcer on the posterior wall. This ulcer is generally just below that fold in the mucous membrane where the gastric mucosa is changing to the duodenal type (Figs. 3 and 4). The ulcers are seared with a cautery and their surfaces sutured over with interrupted catgut sutures. The closure of the anterior duodenal wall is accomplished in layers. The mucous membrane is closed separately and accurately, and a single suture of catgut inverts the seromuscular coat. Interrupted tension sutures of silk are optional. Should the pyloric muscle seem more spastic than normal, its division at right angles to the pylorus is advantageous and requires no change in the subsequent technique (Fig. 5 and 6). It will be found that there is not only no narrowing of the gastroduodenal stoma, but often an increase in its size. It has never been necessary to supplement this operation with a posterior gastro-enterostomy because of pyloric stenosis. The convalescence in these cases has been unusually smooth and free from vomiting and other distressing sequelæ. When this mode of operation has been used, the reduction of the acidity of the contents of the stomach in the first 2 weeks following operation has been found to average just one-half that noted in gastro-enterostomized patients. It should be borne in mind that the duodenal cap has been excised, and subsequent roentgenograms will reveal the same deformity as was found in original ulcer.

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CITRATE VERSUS UNMODIFIED BLOOD TRANSFUSION

A Report of the Comparative Results in a Series of Forty Consecutive Cases Transfused by Each Method; with Special Reference to the Occurrence of Reactions[1]

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REACTIONS following transfusion have been the subject of much investigation and discussion. Although many explanations have been offered for the occurrence of this phenomenon, no one has applied in every instance. Since the introduction of tests whereby the human race is grouped according to the effect of serum on red blood cells either by selection according to group or by mutual matching for compatibility, a certain percentage of reactions have been eliminated.

Mellon and his co-workers have shown the variability of the chemical reaction of commercial sodium citrate. This variation offers a very suggestive explanation. It is the writer's purpose to present the results derived from a study of 40 consecutive cases transfused by the citrate method as compared to 40 cases transfused with unmodified blood; the second series immediately following the first. Reactions are referred to by many authors. Mild ones and severe ones have been described, but in the literature available no precise definition can be found. In order that there may be no misunderstanding of the results herein incorporated, the writer advances as a working definition the following:

A reaction consists of a sharp rise in temperature, accompanied or unaccompanied by subjective or objective symptoms, not attributable to any cause except the transfusion. In the cases transfused by the citrate method, many types of reactions were noted. In most cases the reaction was initiated within 45 minutes after the procedure by a severe prolonged chill which at times was so violent that the bed trembled as the patient shook; accompanied by cyanosis, chattering teeth and rapid pulse. In some instances the chill was mild and of short duration and all patients complained of mental distress. Following the chill there was usually a rise of temperature averaging to between 102–103°. High rises were also encountered, the maximum in one case being 107°. Milder reactions, such as headache, palpitation, and nausea or vomiting unaccompanied by chills were present in a smaller percentage.

A critical study of the charts was made in order to include in the summary offered below any cases which presented any one or any combination of the above symptoms. In other words, only those cases were included as having no reaction in whom there developed no mental or physical symptom that did not exist before transfusion. Bearing in mind the above definition of reaction, a far better understanding of the entire subject can be arrived at, and it is with this idea that the following results are presented.

Table I illustrates the contrast between the occurrence of reactions following the citrated blood and the unmodified blood transfusion methods, respectively. Of 47 cases, 23, or 49.5 per cent, reactions followed the citrate method of administration. In 49 unmodified blood transfusions, no reactions occurred. The highest rise of temperature was to 100.8°, the temperature in some cases being recorded at two-hour intervals. At no time did new symptoms develop, attributable to the transfusion.

TABLE I.—CONTRAST BETWEEN CITRATED AND UNMODIFIED BLOOD

	Modified blood (citrated)	Unmodified blood	Total
Number of cases	40	40	80
Number of transfusions	47	49	96
Number of reactions	23—49.5 per cent	0	
Extremes of quantities transfused	200 and 500 c.cm.	200 and 1020 c.cm.	

The nearest approach to the results described in this communication has been obtained by Lindeman who reports 214 transfusions by his method which were not followed by a chill. His cases, however, were followed by rises in temperature and other symptoms. In our cases there was complete freedom from any symptom. To offer an explanation for the absence of reactions is not easy. The perfection of technique employed in the citrate transfusions compared favorably with that used in the unmodified method. The method of selection of donors was identical. In order to approximate the conditions in the citrate method as nearly as possible to those of the unmodified blood method, the following routine was adopted: The blood was not

[1] Read before the Medical Society of County of Kings, Brooklyn, New York, December 19, 1922.

allowed to stand in the container any longer than it was necessary to transport it to the patients' bedsides and administer it. During transport and administration it was kept warm. These conditions were lived up to as closely as was compatible with human effort. In spite of all these precautions, reactions followed the citrate transfusions as frequently as before.

It is common knowledge that one of the most important requisites necessary for the avoidance of unpleasant sequelæ is the selection of a proper donor. All textbooks and most publications on the subject of matching donors describe and recommend grouping. As far as the recipient is concerned, we disregard this method of selection of donors. We recognize the four groups and prefer to rely upon the direct admixture of blood of the donor and recipient as the criterion of selection (mutual testing) rather than the identification of the group of the recipient and transfusion from an homologous donor. The mutual method of testing used is based upon that originally described by Rous Payton. It is done by calling to the laboratory four prospective donors, each a representative of one of the four groups. Blood is taken from the recipient's vein and mixed with 3 per cent sodium citrate solution in the proportion of one part of citrate to nine parts of blood. Two test tubes are taken for each donor. The donor's finger is pricked, 3 per cent sodium citrate solution is aspirated to the "1" mark on a white blood pipette, and the remainder is filled with blood. The contents of the pipette are then expressed into one of the small test tubes and thoroughly mixed; the mixture is then again aspirated to the "1" mark in the white pipette, that fraction is expelled into another test tube, so that one test tube contains one part of blood and the other nine parts of blood. The white pipette is then thoroughly rinsed with water followed by citrate solution. It is next filled with the recipient's blood—nine parts of this is expressed into the tube containing one part of the donor's blood, the remainder, consisting of one part, is expressed into the tube containing nine parts of the donor's blood. In this way each one of the four donors is tested. After thorough shaking, the blood is allowed to stand at room temperature for 10 minutes and is then examined on a slide with a cover glass, under the microscope, at the end of which time agglutination, if present, can be detected quickly and easily. In none of the series reported was the transfusion followed by any symptom referable to incompatibility. This applies as well to all cases where tests have been done for transfusion not included in the above series. In no instance has there been failure to supply a compatible donor at the first testing of the group of four. In other words, there has been uniform success in securing donors by testing a member of each group by this method, in every instance with satisfactory promptness.

Before this method was adopted, it was not uncommon to prolong the time from the request for transfusion to its performance, for as many as two or three days until a donor who matched could be obtained. Furthermore, the writer's experience has been that although group tests identified donor and recipient as members of the same group, on direct matching agglutination occurred. It is accepted that Group 1, Jansky, or Group 4, Moss, members are universal donors whose red blood cells are not agglutinated by the other's serum. We have observed, however, in a number of cases by mutual match definite and marked agglutination, so much so, in fact, that transfusion from such a donor was not attempted. This opens a field for future study which it is intended to investigate.

Before leaving the subject of testing, it might be well to call attention to a condition which, though troublesome, can be, in our experience, disregarded with safety, i.e., autoagglutination. In two instances in our series we have found that agglutination occurred in the two tubes of each donor, that is, in the eight tubes under observation. Investigation revealed that a mixture of the patient's washed red blood cells with her own serum (both patients being females) showed marked agglutination. This phenomenon has been described in the literature and has been known to give rise to severe anæmia. Both patients were critically ill and upon consultation with the surgeon it was decided to risk the danger of hæmolysis intravitam. Group 1, Jansky, donors were used in both instances with highly satisfactory results; both patients recovered from the transfusions without a reaction, and also, from the diseases for which they were transfused.

One cannot emphasize too strongly, care in testing donors for agglutination. Not only may unpleasant symptoms follow due to carelessness in testing and disregard of hæmolysis, but fatalities may occur during the performance of or soon after the transfusion. With ordinary care, in our experience, at least, reactions and untoward results can be entirely eliminated. This applies as well to retransfusion. It has been emphasized by Libman, Ottenberg, and others that repeated transfusions from one donor may give rise to the production of hæmolysis, which, unless the recipient and donor are tested before each trans-

fusion, may easily be overlooked. Therefore, it is not safe to use a donor who proved compatible on one occasion, a second time, without retesting.

The method of election for the performance of the transfusion should be compatible with the experience of the operator and the environment. The general principle that the more closely the blood introduced into the recipient approximates the blood in its natural condition is a fundamental one. No matter how simple and how easy a method is, if that method permits of changes in the blood due to the admixture of foreign substances, to changes in reaction or temperature, to biological alterations in morphology (coagulation) and to ferment action, it is a departure from this principle. For this reason, the ideal method is that one which permits the blood to be transported from one individual to another quickly, and in as nearly a natural state as possible without operative mutilation to either recipient or donor.

In administering unmodified blood by the above described method, no foreign substance excepting the initial 3 or 5 cubic centimeters of normal saline solution are given to the patient. One is lead, therefore, to the almost unanswerable conclusion that the complete freedom of reactions was due to the administration of pure blood and that the reactions in the former method were due to the added sodium citrate.

It follows, therefore, that wherever possible, the transfusion of unmodified blood is preferable. Many methods have been described and many instruments devised to accomplish this end. Direct transfusion, that is, anastomosis from blood vessel to blood vessel, the blood coming in contact with no foreign substances in its transit, has been discarded as an obsolete method, yet only recently Horsely published the results of fourteen transfusions by this means. The direct method should be heartily condemned for at least three important reasons. First, it is a mutilating operation, as the blood vessels must be exposed; second, there is always danger to a donor when his tissues come in contact with the recipient's (particularly in the infectious diseases); third, one never knows how much blood the recipient is getting or if he is getting any at all.

Many practical instruments have been recommended whereby the blood can be transferred rapidly and efficiently from donor to recipient. Lindeman's method accomplishes it by interchanging numerous syringes with which he aspirates the blood from the donor and then injects the blood into the recipient. Unger uses a very popular instrument with a three-way valve. The transfusions have been performed by means of one of the Miller instruments; first, with the shuttle, and more recently with the valve. The valve is the simplest and more consistent instrument for this purpose. By this method but one assistant is needed, with very little paraphernalia and a transfusion of 500 cubic centimeters can be completed easily within 10 minutes. The method, in short, consists of the introduction of a Nc 18 Kaliski needle into the median basilic vein of the recipient and a No. 15 needle into the donor's vein without incision, the slipping on of the valve, the injection of 3 or 4 cubic centimeters of saline into each vein to insure patency, then aspirating, shifting the valve and introducing. It is imperative in order to insure success of the procedure, that the operator shall have had constant experience in entering veins. Incision and exposure of veins were not resorted to except in three cases, in an infant and in two moribund adults. The patients were moribund and the circulation was in such a state of collapse that the veins could not be distended and entered without exposure.

The transfusion of modified blood should only be done when it is impossible to administer unmodified blood—such conditions never arise in a well equipped hospital. The writer fully agrees with Bernheim in condemning the citrate transfusion for hospital use.

It is true that patients at times seemed too sick to be moved to the operating room where unmodified blood transfusions can best be done. We have overcome this difficulty in one of two ways; either by doing the transfusion at the bedside without moving the patient, or moving him with great precaution. The surgeon does not hesitate to move a patient to the operating room for a surgical procedure under the most desperate conditions and such conditions are no exception for transport for transfusion.

It is always well, after initiating the transfusion to inject carefully the first 40 or 50 cubic centimeters of blood slowly, meanwhile watching the patient carefully for the development of anaphylactic symptoms. These consist of sharp excruciating pain in the back, slight dry cough, and dyspnœa, the pulse as a rule giving no indication of the advent of this phenomenon. The transfusion must be discontinued, if such symptoms appear. In their absence, however, the blood may be injected more rapidly, the rate depending upon the general condition of the patient, particularly upon the cardiac and pulmonary status. With this method, under proper and average conditions one should be able to

transfuse at least 1000 cubic centimeters of blood without changing syringes.

The reasons for transfusions should be as clearly indicated as are the conditions for all operative procedures. The fact that a patient is desperately ill or is dying, and every medical and surgical resource has been exhausted does not necessarily indicate transfusion. At the same time transfusion has been instrumental in literally pulling a patient out of the jaws of death. A glance at our statistics, Tables II and III, will emphasize this fact. The most satisfactory results were obtained in cases of hæmorrhage which include those of obstetrical, postoperative and hæmophiliac origin, and also the anæmias, either primary or secondary. A number of these cases were almost moribund and their response to the infusion of blood was short of miraculous. It might be mentioned that in none of these cases were massive transfusions given, as practiced by some authors. The maximum amount transfused at any one time was 1020 cubic centimeters in two cases of exsanguination. For purposes of convenient study the cases have been divided into three great groups, namely, sepsis, the anæmias, and hæmorrhage. The sepsis cases were the most hopeless. They included bacteræmic conditions, postpartum sepsis, etc., with a mortality in 26 cases of 53 per cent.

The anæmias include those of the primary Addisonian type, and those accompanying malignancy, in addition to secondary types of varied origin. The statistics in this group are favorable, when we consider that some were done in cases preparatory to operation for extensive surgical procedures, and in cases where the best that might be hoped for was a remission of symptoms or a slight prolongation of life. The mortality in this group in spite of the unfavorable outlook was 29.6 per cent in 27 cases.

The best results have been obtained in the hæmorrhagic conditions. Postoperative shock has been included in this group because of the difficulties in differentiating it from hæmorrhage. Most of this latter group occurred after gall-bladder surgery, and on investigation were found to be a combination of both. The deaths that occurred in this group were cases in which the symptoms developed within 12 hours of operation. Transfusion temporarily relieved symptoms, but the patient died a short time afterward. Those cases which developed signs of hæmorrhage several days after operation, invariably showed immediate improvement, and recovered, although a few needed retransfusion. If we deduct the eight cases of postoperative shock, the results are very impressive, in that but 3 of 20 cases died, a mortality of 15 per cent. Many of the cases were desperately ill, some almost exsanguinated.

It is true that we cannot with any degree of surety state that transfusion saved the lives of all the cases that recovered. That transfusion in many of the cases acted as a contributory factor toward improvement or recovery cannot be questioned. And, in studying the individual records, and after reviewing individual cases, certain ones stand out in which transfusion turned the tide of life from the open sea of death and landed the patient safely upon the shores of the living.

TABLE II.—END-RESULTS IN 80 CASES TRANSFUSED

	Per cent	Cases
Recovered	38.75	31
Improved	16.25	13
Unimproved	7.50	6
Died	37.50	30
Transfused in moribund condition		4
Death possibly accelerated by transfusion		1

TABLE III.—TYPES OF CASES TRANSFUSED—WITH END RESULTS

	Rec.	Imp.	Unimp.	Died	Total
Sepsis					
Postpartum	7	..	..	7	14
Surgical	3	1	..	2	6
Bacteræmias	..	2	..	1	3
Miscellaneous	..	1	..	2	3
Anæmia					
Primary	..	4	1	2	7
Secondary	3	3	1	..	7
Malignancy	1	2	..	1	4
Pre-operative	1	1	1	4	7
Miscellaneous	..	..	1	1	2
Hæmorrhage					
Hæmophilia	3	..	..	..	3
Postoperative	4	..	..	..	4
Obstetric	3	..	..	..	3
Uterus (fibroma)	3	..	..	1	4
Gastric (ulcer)	1	1	..	2	4
Miscellaneous	1	..	..	..	1
Postoperative shock	1	..	..	7	8
	31	13	6	30	80

It is true that we cannot with any degree of surety state that transfusion saved the lives of all the cases that recovered. That transfusion in many of the cases acted as a contributory factor toward improvement or recovery cannot be questioned. And, in studying the individual records, and after reviewing individual cases, certain ones stand out in which transfusion turned the tide of life from the open sea of death and landed the patient safely upon the shores of the living.

SUMMARY

Post-transfusion reaction is defined as a sharp rise in temperature, accompanied or unaccompanied by subjective or objective symptoms, not attributable to any cause except the transfusion.

Reactions followed in 49.5 per cent of 47 cases transfused by the citrate method, as compared to no reactions after 49 unmodified blood transfusions. Mutual testing for incompatibility is preferable to blood grouping.

TREATMENT OF DISLOCATED SEMILUNAR CARPAL BONES[1]

By GEORGE G. DAVIS, M.D., F.A.C.S., Chicago

UNTIL recently, as a rule, the treatment of a dislocated semilunar carpal bone might be summed up in three words—"take it out." More recently, however, a rather conservative therapy has entered the field and a more persistent effort is made at reduction.

In discussing the treatment we might divide the cases into three groups: Group 1, in which the dislocation is diagnosed immediately. This group is treated by manipulation. Group 2, in which the dislocation has not been diagnosed for a number of weeks or months or where the dislocation has not been reduced by manipulation. In this group, the open reduction with the use of a "semilunar skid" should be the procedure of choice. Group 3 comprises old cases which have not been diagnosed or have refused operation, or having been dislocated for a year or more, open operation has failed. In this last group and only in this group, it seems that the semilunar bone should be removed.

In using the term "dislocated semilunar bone" we may include cases in which the semilunar bone itself really is in position with its radial articulation in contact with the radius, but the os magnum with the rest of the hand is dislocated to the dorsal surface of the os semilunare (Fig. 4); and also, of course, we may include cases of true dislocation where the os semilunare is displaced from its articulation with the radius, its concave surface facing the palm of the hand and its radial articulation surface in contact with the os magnum, which now articulates with the radius (Fig. 10).

In the first group of cases, that is, where the diagnosis of a dislocated semilunar bone has been made immediately following the injury, we have been able to accomplish a reduction by a manipulation that may be termed the "broom stick method." This is merely the application of "Gunn's law" in reduction of the dislocation with the aid of the sawed-off end of a broom stick. Gunn called attention to the value in the treatment of dislocations in placing the dislocated member in the position it was at the time of injury and reversing the force.

In analyzing the force producing this dislocation, it is constantly found that the hand is pushed in a dorsal flexion position, that is, the force is directed from palmar to dorsal hand direction. A second force is exerted by the muscles and ligaments going from the forearm to the hand, pulling the hand toward the arm. The position of the hand at the time the dislocation is produced is that of extreme extension.

Hence according to Gunn's law, to reduce the dislocated semilunar the hand would be placed in extreme extension. One reversed force to be employed would be from the dorsal to palmar direction, that is, flexion of the wrist, and a second and simultaneous reversed force would be a pull on the hand to overcome the tension of the muscles going from forearm to hand. But this generally is not sufficient to reduce the dislocation, as the semilunar bone is loose and able to move with the flexion of the hand.

Therefore, to prevent the os semilunare from turning with the flexing hand, the curved surface of the side of a broom stick handle is placed at the lower tip of the os semilunare on its radial articulation aspect (Fig. 3). Thus the upper end of the os semilunare is pushed back into place and its concave surface engages the os magnum. The pull on the hand in a distal direction in-

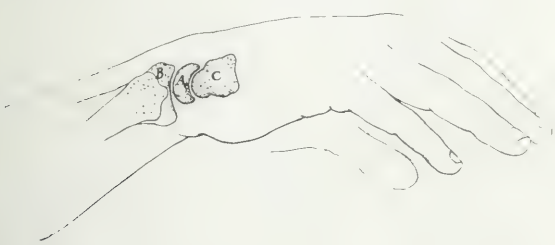


Fig. 1. Diagram showing the normal relationship of *a*, the semilunar bone, to *b*, the radius, and *c*, the os magnum.

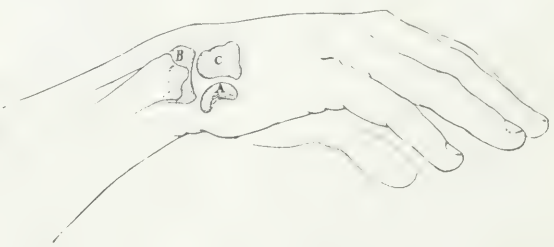


Fig. 2. Diagram showing the relationship of *a*, the dislocated semilunar bone, to *b*, the radius, and *c*, the os magnum.

[1] Read before the joint session of the American Association of Railway Surgeons and Association of Chicago, Milwaukee & St. Paul Railway Surgeons, October 19, 1922.

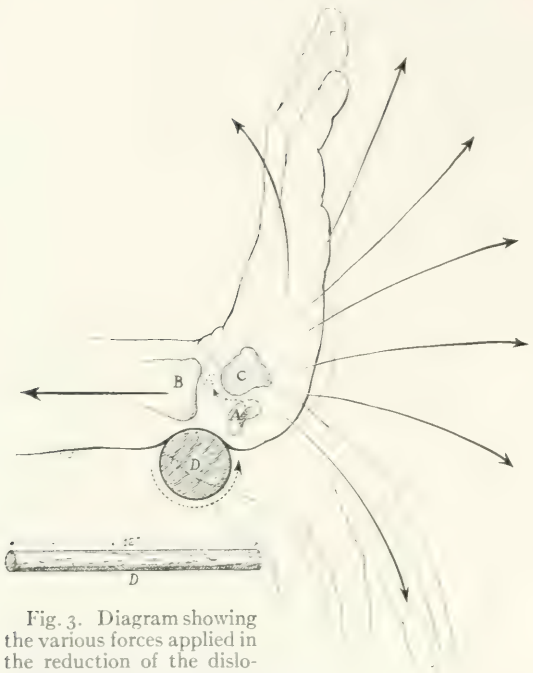


Fig. 3. Diagram showing the various forces applied in the reduction of the dislocated semilunar bone by the *d* "broom stick end method." The arrows indicate the direction of the various forces applied.

creases the space between the radius and the os magnum, making room enough for the os semilunare to return to its place as the hand is flexed. Case 1 (Fig. 4) was reduced by this method.

J. D., 39 years old, on August 4, 1921, received an injury to the left wrist causing a dislocation of the os semilunare and a simple fracture of the tip of the radius. After a roentgenological examination the diagnosis was made the same day that the injury occurred. On the following day, August 5, 1921, under an ether anæsthesia, an attempt at reduction with the "broom stick handle method" was attempted. A roentgenological examination after the operation showed a complication that may happen by this method. The lower palmar end of the os semilunare was pushed too firmly by the broom stick and the os semilunare was turned to the palmar aspect of the os magnum (Fig. 5). However, a second manipulation under ether with less force applied with the broom stick allowed the bone to fall into its normal position (Fig. 6).

When this method fails, which is generally the result where the case has not been diagnosed early or the patient has refused operation and months (8 to 12) have elapsed, then an open operative attempt at reduction should be made.

In this open reduction the writer has found it convenient to use a skid for the reduction of the dislocated semilunar carpal bone. The skid herein described is not new in principle as applied in fractures of the long bones. It is designed to overcome many of the difficulties experienced in open reduction of the dislocated semilunar bone, especially in cases in which the dislocation has existed over an extended period.

In the open operation with incision over the dorsal surface of the wrist, the operator finds several obstacles confronting him. There is but

Fig. 4. (Case 1.) Roentgenograms in lateral and anteroposterior views showing the os semilunare to the palmar aspect of the os magnum, yet its normal articulation with the radius is preserved.

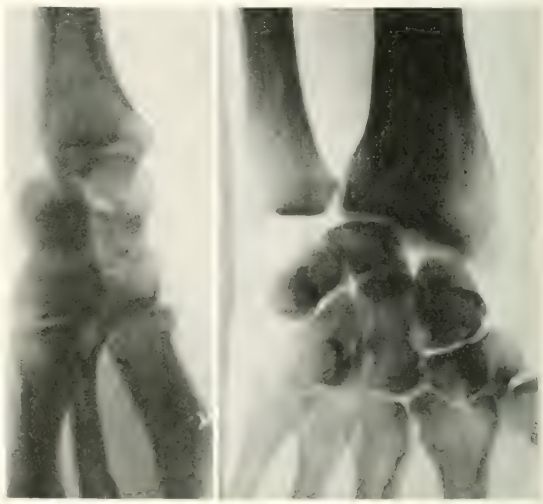


Fig. 5. (Case 1.) Roentgenograms in lateral and anteroposterior views which were taken after the first attempt at reduction with the "broom stick method," showing incomplete reduction.

Fig. 6. (Case 1.) Roentgenograms in lateral and anteroposterior views taken after second attempt at reduction with "broom stick method," showing complete reduction.

little space between the articular surface of the radius and the os magnum, which articulates with the radius when the semilunar is dislocated. With flexion of the wrist and traction on the hand and counter traction of the arm, the space between the two bones is increased, but not enough for reduction of the semilunar bone, and the operator now finds himself embarrassed for a suitable instrument to pull or pry the semilunar back into place. There is no instrument in the general surgical armamentarium to meet this special need. A clamping instrument intended to pull the semilunar will damage the bone by crushing. A straight or single-curved instrument applied between the os magnum and the semilunar for the purpose of prying the semilunar into place crushes the os magnum.

It is on account of this difficult approach to the semilunar and the resulting injury to the carpal bones that the majority of textbooks recommend the removal of the bone rather than the reduction It is to overcome this difficulty and to save the bone that the "semilunar skid" is designed.

The skid, which is made of nickel steel, is curved on the flat surface (Figs. 7 and 8), and is thin enough to slide between the closely wedged bones. The upper border of the semilunar articulation surface which normally articulates with

Fig. 7 (above). "Skid" for reduction of dislocated semilunar bone—view from above and the side. The instrument is 8 inches in length and tapers from ½ inch in width at the middle to ¼ inch at the end, and varies in thickness from $\frac{3}{16}$ of an inch at the middle to $\frac{1}{16}$ at the tip. It has an S-shaped curve at the end. The distal curve, ¼ inch in length, a large arc of a small circle, is to receive the tip of the semilunar bone; the proximal curve, ½ inch in length, a small arc of a large circle, is to receive the os magnum.

Fig. 8. Lateral view of "skid" showing the two parts of the S-shaped curve; the distal curve for the tip of the semilunar bone and the proximal curve for the os magnum.

the os magnum (Fig. 1 and 2), slides to the volar surface of the os magnum when the semilunar is dislocated. To get the upper border of the articular surface up and back and to apply pressure enough on the os magnum to allow the semilunar to skid back into place, the "semilunar skid" is well adapted (Fig. 9). The distal curve of the skid engages the tip of the semilunar and the proximal curve skids over the os magnum.

Though the dislocation has lasted a number of weeks, or even months (Figs. 10 and 11, and 12 and 13), the reduction with the use of the "semilunar skid" can be accomplished without injury to the bones.

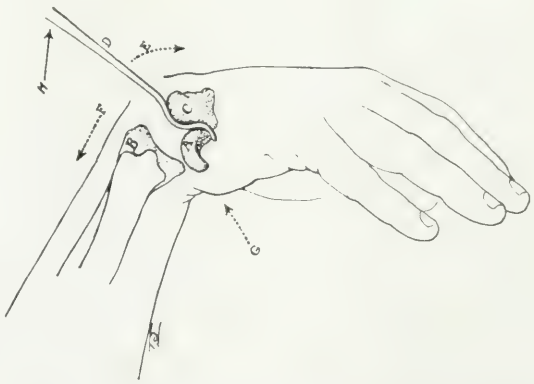


Fig. 9. Diagram showing, *d*, the "skid" and its relationship to, *a*, the dislocated semilunar bone, *b*, the radius, and *c*, the os magnum. The arrows mark the direction of the various forces applied to accomplish the reduction of the semilunar. The force applied to the handle of the "skid" is directed distalward and dorsalward; the force applied to, *c*, the os magnum and hand is directed distalward and toward the volar surface (flexion of the wrist); *f*, counter extension is applied to, *b*, the radius (and arm); *g*, pressure applied to the volar surface of the wrist, directed against the semilunar bone.

Fig. 10. (Case 2.) Roentgenograms in lateral and anteroposterior views showing dislocation of os semilunare.

Case 2. V. S., a boiler maker, on May 25, 1922, received an injury to his left wrist. There was a chipping fracture of the ulna and radius. He had also at that time, a dislocated semilunar carpal bone which was not diagnosed (Fig. 10). On July 12, the diagnosis of a dislocated semilunar was made, that is, 7 weeks after the dislocation.

Fig. 11. (Case 2.) Roentgenograms in lateral and anteroposterior views showing the os semilunare in proper position after reduction by the "skid" method. The dislocation had been present for 8 weeks.

The "broom stick method" was tried in this case and failed. On July 20, or 8 weeks after the dislocation, the

Fig. 12. (Case 3.) Roentgenograms in lateral and anteroposterior views showing dislocation of the os semi lunare, which was not recognized at time of injury.

Fig. 13. (Case 3.) Roentgenograms in lateral and anteroposterior views showing the semilunare in proper position after reduction by the "skid method." The dislocation had been present for 3 weeks.

Fig. 14. (Case 4.) Roentgenograms in lateral and anteroposterior views showing dislocation of the os semilunare.

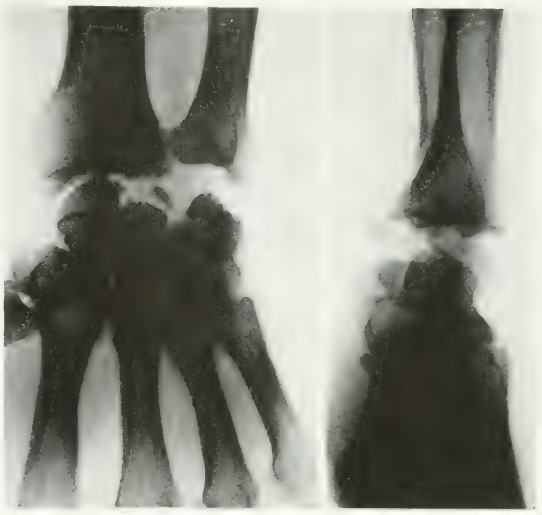


Fig. 15. (Case 4.) Roentgenograms in lateral and anteroposterior views showing fragments of the os semilunare remaining when the bone was removed after an unsuccessful attempt at reduction. The dislocation was of 21 months' duration.

open method with the use of the "skid" was employed and the semilunar bone was readily reduced and good function of the hand has resulted (Fig. 11).

Case 3. R. F., a miner, received an injury on September 4, 1920, and a dislocation of the semilunar bone resulted (Fig. 12). This, however, was not diagnosed at the time. The diagnosis of a semilunar was made about 3 weeks later and on September 27, the open operation with the "skid" was performed and a successful reduction of the semilunar was accomplished (Fig. 13). This patient, seen some months afterward, showed an excellent functional result.

In the third group of cases where the dislocation has remained for 6 months or a year without a diagnosis being made and without an attempt at reduction having been made, the chances are poor for a return of the os semilunare to its normal position with a functional result. However, the open reduction with the use of the "skid" should be attempted.

If a reduction then can not be accomplished it is advisable to remove the bone by an anterior incision rather than to endeavor to take it out through the usual dorsal incision employed in the open reduction, as it is very difficult to remove it *in toto* by this route, and a fragment left in may cause considerable disability in the flexion of the hand, as noted in one of the writer's cases.

Case 4. A. G., a roofer, received an injury to his right wrist on July 14, 1919, and a fracture of the radius was diagnosed, but the dislocation of the os semilunare was overlooked. It was not until April 17, 1921, or 21 months after the injury, that the diagnosis of dislocated os semilunare was made (Fig. 14). The open reduction with a posterior incision and the use of the "skid" was attempted in this case. It was found that the os semilunare was bound down by dense adhesions and it was impossible to slip it into its normal position. An endeavor was made through this posterior incision to remove the bone. The bone was broken into pieces in this endeavor and portions removed. On roentgenological examination following the operation, it was found that a number of pieces of bone was left on the palmar aspect. The patient refused a second operation to remove these portions of bone. The result was not good. There was a loss of function due to these remaining portions of bone. In such cases, therefore, it would seem advisable, when an endeavor has been made to reduce the os semilunare by the posterior incision and the reduction is impossible, that a better policy would be to make a new incision upon the palmar aspect of the wrist and remove the bone by that incision.

INTESTINAL CLAMP WITH DETACHABLE HANDLE

By LINCOLN DAVIS, M.D., F.A.C.S., Boston

THESE clamps were devised for use in the operation of excision of the rectum by the combined abdominoperineal method with establishment of permanent colostomy in one stage.

The instrument consists of a strong hinged clamp with longitudinally grooved blades 4 inches long (Fig. 1, *a*). The backs of these blades are grooved to permit the application of the small locking clamp with thumb screw (*b*) by means of which the clamp is held firmly closed, and slipping prevented. A pair of strong clamp handles with ratchet lock, whose blades are shaped to enclose and hold the blades of clamp (*a*) by means of slightly flexible clips completes the instrument (Fig. 2).

The clamps are used as follows: the blades, held as in *a*, Figure 3, are applied to the intestine at the point selected for resection. Two pairs are applied across the intestine parallel to each other with an interval of a quarter of an inch of intestinal wall or less between the two sets of blades. The handles are then set up and firmly locked, the intestine severed with the cautery between the blades, the tissue being charred down to the surface of the clamp, completely sterilizing the field. The small locking clamp is then applied to the middle of the intestinal clamp blades and set up by means of the thumb screw (*b*, Fig. 1), the handles are then removed (*c*, Fig. 1).

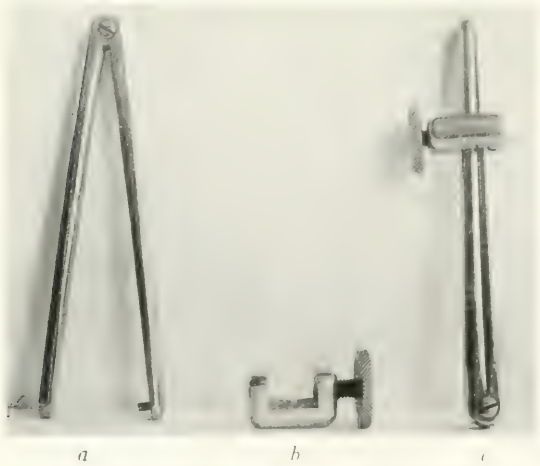


Fig. 1.

The proximal clamp is brought out through the colostomy wound, the clamp being opened after 48 hours. The distal clamp is dropped down into the pelvis with the freed up portion of gut to be removed, and the toilette of the pelvic peritoneum completed above it; the rectum and sigmoid are then removed from below by the perineal route, the clamp acting as a guide.

Fig. 2.

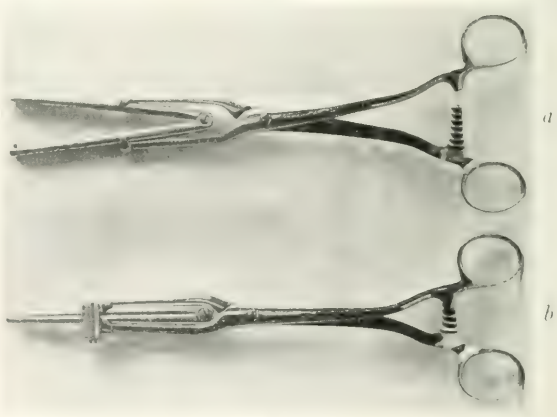


Fig. 3.

The advantages claimed for these clamps are (1) that they permit of severing the bowel in an aseptic manner, with the expenditure of a minimum amount of time; (2) after removal of the long handles the locked clamp blades may be conveniently passed through a small colostomy wound, or temporarily dropped into the true pelvis.

I have found the instrument useful in a number of cases.

EDITORIALS

SURGERY, GYNECOLOGY AND OBSTETRICS

FRANKLIN H. MARTIN, M.D. ..... Managing Editor
ALLEN B. KANAVEL, M.D. ..... Associate Editor

AUGUST, 1923

CAUSE OF THE HIGH COST OF HOSPITAL CARE

THE Lincoln is the ideal motor car. Therefore, all doctors should attend their patients in such a vehicle and charge the overhead to the patient. We are following this principle now in hospital construction and we will perhaps get around to the standardization of the automobile a little later. Hospital architects are building artistic palaces in which they reserve some spaces where patients can be kept. The products are ideal. For the common people, however, ideality is merely a state of mind, not a reality to be achieved.

It has been aptly stated that only the rich and the indigent can get the best medical and hospital care. Here is one of the fundamental reasons. The high cost of the hospitals means not only the great initial cost but, what is of more importance, the increased upkeep. The public can usually be induced to build the hospital, but once it is finished they assume the task is finished; those who are responsible for the conduct of the hospital know the work has just begun. The final burden rests, however, on the pay patient. If he cannot pay he must be treated at home. An ideal hospital is one which achieves its purpose. Palaces for the rich are quite in order, but it should be remembered that good hospital care can be provided in buildings of low cost and small overhead. They may lack many things desirable, yet they achieve a great good. The ideal Christmas tree is one so small that the children can reach the candy. The small community hospitals are reaching the needs of people of moderate means more efficiently than the palatial institutions because they are within reach of the average citizen. The most of us reach our daily task with the aid of an automobile of low initial cost. It is not ideal but we get there on time just the same, provided we start early enough, and at a tremendous saving of the overhead. Those who have to do with the standardization of hospitals do perhaps not fully appreciate the limitations of the purse of the average citizen.

Material equipment is often too much stressed. The reason is that this is easy to do. The effort required is less than the standardization of the more human factors. There might be no criticism of this were it not that it has as result the education of the public to the belief that the kind of hospital determines the product. It is a common thing for a group of doctors to assure the public that the building of a hospital would bring with it efficient medical service. This is education in the wrong direction. It takes the responsibility from the medical profession, where it belongs. A patient is better off in the kitchen with a surgeon than in the best appointed operating room threatened by an operator. Medical talent, not palatial hospitals, is the need.

ARTHUR E. HERTZLER.

DIVERTICULA OF THE URINARY BLADDER

A STUDY of the indices of medical literature during the past decade shows a gradually increasing number of articles relating to conditions formerly considered to be of rare occurrence. The development of more accurate means of diagnosis, of the roentgenogram in particular, is showing not only that these conditions are not rare, but also that to their existence are to be ascribed signs and symptoms which formerly were either not understood or were wrongly interpreted.

Among such conditions which are now known to be of fairly frequent occurrence are included those structural anomalies of the urinary bladder known as diverticula. It is only within comparatively recent years that the existence of these pouches which develop in the wall of the bladder has been generally recognized, only five cases having been reported in the United States previous to 1906. With the development of cystoscopy and of cystography, however, it has become possible to diagnose with certainty the number, location and size of these diverticula, for they may be single or multiple, may occur in any portion of the bladder and may vary in size from a small pocket, which barely admits the tip of the finger, to a sac the capacity of which is equal to that of the entire bladder cavity. A diverticulum may have a fairly wide opening, or it may communicate with the bladder by a very small opening, thus simulating a pedicled tumor in its roentgenographic outline. In the diagnosis of this condition, therefore, close co-operation between the urologist and the roentgenologist is essential.

There is a difference of opinion among urologists as to the etiology of diverticula, that is, as to whether they are congenital or acquired. In the light of E. M. Watson's observations, however, it seems probable that there is a congenital predisposition to their formation, but that "their clinical recognition during adult life is hastened and their dimensions greatly increased by any of the factors that would bring about increased vesical distention or increased activity of the bladder musculature." This opinion is strengthened by the fact that diverticula nearly always occur in males in whom also the urinary outlet is more frequently obstructed.

Diverticula present no specific symptoms. Their presence should be suspected, however, in any case in which difficulty of urination, frequency, and pyuria exist as concomitant conditions, and wherever there is persistent pyuria especially after repeated irrigations. Any abnormality of micturition should be an indication for a cystographic examination of the bladder which should include an anteroposterior plate and at least two plates taken from different angles.

It is obvious that once a diverticulum becomes infected, no medical treatment can be effective. Irrigations may be palliative, but in many cases the diverticulum cannot be irrigated as contractions of the bladder will often close its opening. It follows that the only curative treatment is complete removal.

There is a difference of opinion as to the best method of diverticulectomy but the writer's experience has been that a large diverticulum can be most readily removed after first packing it with gauze or cotton so as to convert the sac into a semi-solid tumor. The entire sac can then be readily dissected free from the surrounding tissues, its attachment to the bladder severed, and the opening in the bladder closed. In closing the diverticulum opening in the bladder, the mucosa should be turned in and sutured so as to leave a slight ridge rather than a depression on the inner surface of

the bladder as a depression would cause a tendency to recurrence.

A small diverticulum which can be readily picked up with forceps and drawn within the bladder is satisfactorily removed intravesically.

Any cause of obstruction which may be present—enlarged prostate, stricture, cicatricial contraction of the vesical neck, etc.—should be remedied to prevent recurrence of the diverticulum. If a ureter opens into a diverticulum, as frequently happens, it should be transplanted.

In view of the almost uniformly satisfactory results of diverticulectomy and the inevitable progress of the ill effects due to the presence of diverticula, operation should not be delayed once their presence has been determined by the aid of the cystoscope and the roentgenogram.

W. E. Lower.

MASTER SURGEONS OF AMERICA

WILLIAM STEWART HALSTED

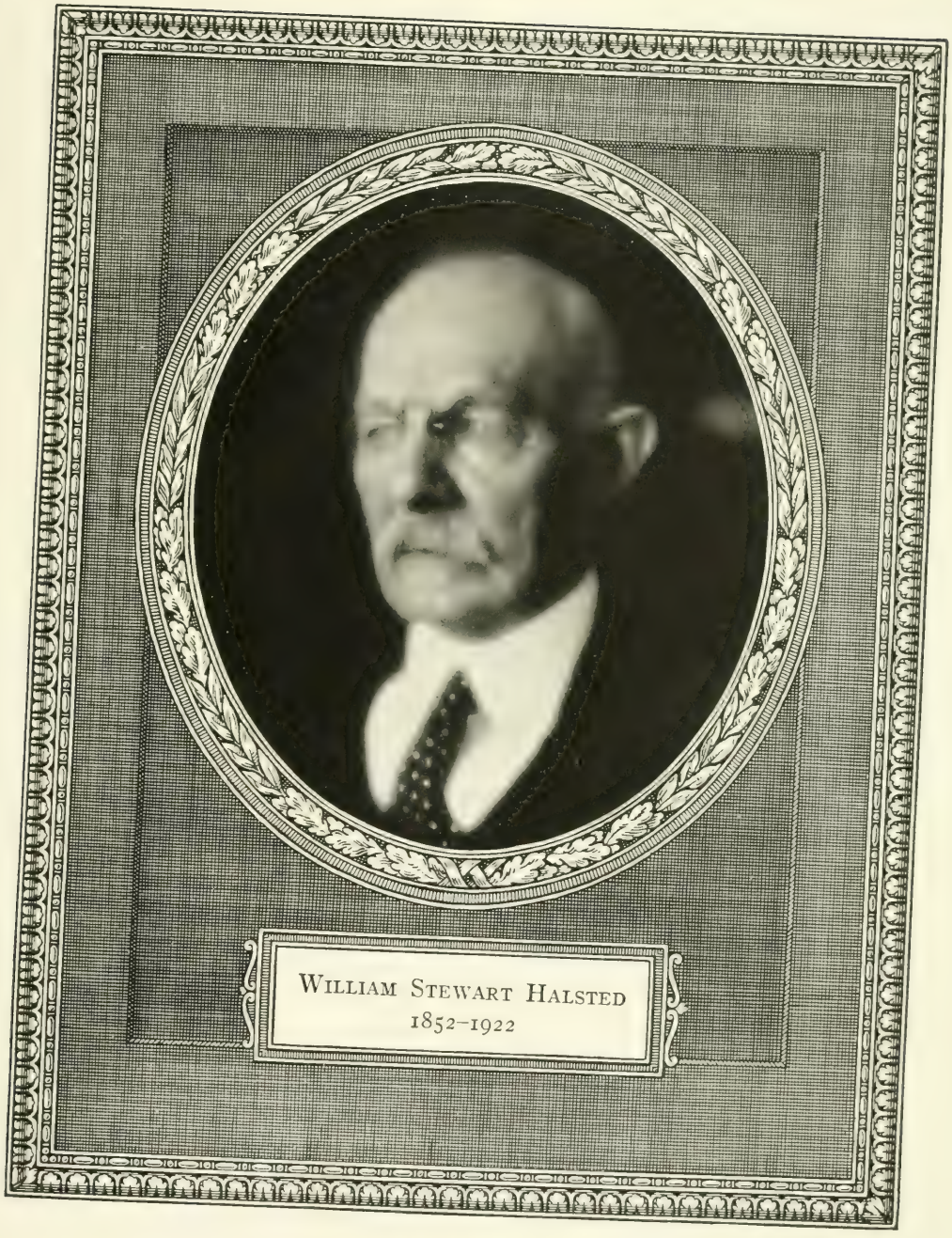
William Stewart Halsted, M.D., Sc.D., LL.D., Hon. F.R.C.S., F.A.C.S., Professor of Surgery in The Johns Hopkins University and Surgeon-in-Chief to Johns Hopkins Hospital, was born in the city of New York on September 23, 1852, and died in Baltimore on September 7, 1922.

Dr. Halsted was of English ancestry, descended from a family prominent in the social, business, and philanthropic life of New York. He was the son of William M. Halsted, Jr., and Mary Louisa Haines Halsted.

Dr. Halsted prepared for college at Phillips Academy, Andover, Massachusetts. He was graduated from Yale University with the A.B. degree in 1874. He studied medicine in the College of Physicians and Surgeons, now a department of Columbia University, and was graduated in 1877 at the head of his class, for which he received the first prize of one hundred dollars. He served as surgical interne and later as house surgeon in Bellevue Hospital from 1876 to 1878. He was the first house physician in the New York Hospital where he served for a short period in 1878, leaving this service to go abroad where he studied for 2 years, chiefly in Vienna, Leipzig, and Wuerzburg. Upon his return to New York he was made assistant demonstrator of anatomy in the College of Physicians and Surgeons, and later became demonstrator of anatomy, which position he filled with great distinction until 1885.

He began the practice of surgery in the fall of 1880. From the beginning he limited his practice to surgery, and in all probability was the first in this country to confine himself exclusively to this specialty. About the same time he was appointed attending surgeon to Presbyterian and Bellevue Hospitals and assisting attendant surgeon to Roosevelt Hospital. He was also chief surgeon to the dispensary of the latter hospital from 1881 to 1886. In addition to all this he was surgeon-in-chief to the Emigrant Hospital, Ward's Island; attending surgeon to the Charity Hospital, Blackwell's Island; and substitute attending surgeon to Chambers Street Hospital.

Upon his return from Europe in 1880 Dr. Halsted organized a corps of teachers called a "quiz," for the purpose of higher medical education. None but graduates of first-class colleges was accepted. Associated with him in this work were such men as Frank Hartley, George M. Tuttle, William G. Thompson, George E. Munroe, and West Roosevelt. All of the teachers in this quiz had hospital



William Stewart Halsted
1852–1922

appointments and hence could give the students dispensary, bedside, and laboratory instruction. As an evidence of the thoroughness with which the instruction was given by this able corps of instructors headed by Dr. Halsted, of the last class graduated from this quiz eight were on the honor list of ten in the College of Physicians and Surgeons, and of the first twelve in the graduating class that year ten were from this quiz. Thus his subsequent contributions to the science and art of surgery as author, investigator, teacher, and trainer of men were but the natural fulfillment of the early promise exhibited in his brilliant achievements during this busy period of his career in New York.

As a direct result of the character and extent of his work during this period, his health suffered and he was compelled to relinquish his work for a time. His health having improved, Dr. Halsted, in 1887, came to Baltimore as one of that brilliant coterie of men who had been attracted thither by the unequalled opportunities offered in the newly opened Pathological Laboratory of the Johns Hopkins University under the inspiring leadership of Dr. Welch. Here he became at once identified with, and a leading spirit in, the new Johns Hopkins School of Scientific Medicine. In the early days of this development he was associated with such brilliant pupils of Dr. Welch as Mall, Councilman, Nuttall, Walter Reed, Abbott, Flexner, and many others of like mind. No wonder then that Dr. Halsted, with his splendidly trained mind, his scientific curiosity, and his wide experience and interest, developed rapidly in this congenial atmosphere and was not long in embarking upon that career of unrivalled productiveness along all lines of surgical progress that has marked his connection with The Johns Hopkins from beginning to end. Here he founded a school of surgery, based upon the most approved scientific principles, the distinguishing characteristics of which were honesty of purpose and thoroughness in method. It is impossible thus early to appraise at their true value the various elements that contributed to raise Dr. Halsted to the high position that he undoubtedly occupied in the surgical world. The proper perspective is hardly possible so soon after the close of his remarkable career. But to those who were privileged to serve under him, to benefit by his inspiring leadership, his wise counsel, and stimulating example, the one thing that stood out with greater prominence than anything else was his earnest search after and his passionate love of the truth. Everything else was subordinated to this. It made no difference whether or not the truth, when finally discovered, confirmed or overthrew his preconceived ideas or previously enunciated theories. His absolute honesty made him always the first to call attention to his own mistakes. The painstaking care, however, with which his work was planned and the scientific accuracy with which it was performed made this rarely necessary.

Dr. Halsted has expressed himself upon more than one occasion as convinced that the best result of his arduous labor was the development of a group of younger surgeons trained under him in modern scientific methods, and thoroughly

imbued with the same high ideals of surgical honesty. Among all of his contributions he personally attached greatest importance to the law discovered and enunciated by him in connection with the investigations of the action of parathyroid autografts in the dog, namely, "that unless considerable deficiency in parathyroid tissue has been created, the autografts do not live."

From the first publication that appeared under his name, the report of a case of intestinal incarceration operated upon by him, appearing in the *Medical News*, January 27, 1883, surgical literature has been continuously enriched by the many thoughtful and erudite studies that have come from his laboratory. This was truly his workshop, for the clinical side of his work interested him comparatively little, although all of his publications had a very practical application, many of them pre-eminently so, for example, his introduction of the use of rubber gloves in surgery, his insistence upon the most meticulous care in the gentle handling of tissues, absolute asepsis, complete hæmostasis, etc.

Personally, "The Professor," as he was familiarly called by his staff, was a curious mixture of contradictions; abnormally shy and sensitive as a woman; to a stranger reserved to a degree; and yet to his few intimates the most charming of companions; endowed with a keen yet kindly sense of humor, and at the same time with a wit that upon occasion could be caustic in the extreme. To his associates and assistants he was always stimulating and helpful, even if at times he may have felt it necessary for their good to apply the Biblical adage, "Faithful are the wounds of a friend."

Dr. Halsted was in the truest sense of the term a Master Surgeon. There was nothing that concerned either the science or the art of surgery that did not hold something of interest for him. While his natural bent inclined rather toward the science than the art of surgery, still the list of his contributions covers pretty much the entire range of both phases of the subject. The number of his publications reaches well over a hundred, all valuable and many original pieces of research, and some epoch-making, e.g., his work upon the radical cure of cancer of the breast and of inguinal hernia, nerve blocking, etc.

Dr. Halsted has, by the wide range and excellent character of his work, given prestige and renown to American surgery and earned the right to have his name enrolled among those of the great immortals. To scientific surgery, to the institutions with which his name has become inseparably connected, to his pupils and friends who enjoyed the inestimable privilege of his inspiring companionship, his death means an irreparable loss.

"Now is the stately column broke,
The beacon's light is quenched in smoke,
The trumpet's silver sound is still,
The warder silent on the hill."

J. M. T. Finney.

TRANSACTIONS OF SOCIETIES

CHICAGO GYNECOLOGICAL SOCIETY

Regular Meeting Held February 16, 1923, Dr. Henry F. Lewis, Presiding

SPECIMEN SHOWING FASCIA BETWEEN PELVIC ORGANS

Dr. Joseph B. De Lee: The specimen I present to you shows beautifully and clearly the various layers of the pelvic fascia. You have heard mentioned several times in our meetings the fascia that exists between the bladder and uterus. I never knew that it could be so beautifully dissected.

The specimen shows how the organs of the pelvis, the bladder, vagina, and rectum can be dissected absolutely free from the fascia surrounding them, leaving thick layers of connective tissue. If I should remove the lining membrane of these hollow viscera the fascia would still present their shapes. I show you the rectum with the fascia belonging to it. The bladder is dissected from its investing capsule or fascia, and this particularly I wish to bring to your attention because that is the fascial layer which we reduplicate in the low cervical cæsarean operation. The specimen was presented to me by Professor Tandler of Vienna.

In his collection I saw a specimen in which the levator ani muscles were attached to the so-called white line. I saw other specimens in which the levator ani muscles were attached below the white line, and in one of them it was one-half inch above the white line.

The origin of the levator ani is not constant in the human female. In discussing it with Professor Tandler he told me that sometimes the levator ani extended as far back as the spine of the ischium That was the point of contention between Dr. Barrett and myself the last time we discussed this subject. The levator ani may be inserted one-half inch below the spine of the ischium.

These differences we clinicians have not appreciated in the past, in consequence of which they have led to all sorts of acrimonious discussion.

Another point: Professor Tandler, as an anatomist, has done a great deal of work on the pelvic organs, and he has an interesting theory regarding the causation of prolapse. He says the levator ani as it curves from the coccyx around and up behind the rectum and down toward the anus forms a beautiful S-shape, which curve is destroyed during labor. In the normal human being the cervix slips back into the hollow made by the coccyx and the curves of the muscle. When the fetal head comes down and destroys the hollow, it straightens out the levator ani, and the cervix slides down the straightened muscle. This theory is very beautiful and was borne out by some of the specimens he was able to show me.

BACTERIA IN THE BLOOD VESSELS OF CHORIONIC VILLI; HYDATIFORM MOLE

Dr. J. P. Greenhill: The patient, a primipara, 15 days overdue, who had been given castor oil and quinine three times without avail, was admitted to the Chicago Lying-In Hospital for induction of labor. A bougie was inserted into the uterus but failed to stimulate pains. The next day a Voorhees bag was introduced and after 6 hours of labor pains, was expelled spontaneously. The cervix at this time was dilated only 6 centimeters. There was a cessation of pains, which did not recur until the following day, during which pains were irregular. On the evening of the third day, the temperature rose to 102.4° and the pulse to 116. Because of the elevation of temperature, acceleration of pulse, and irregularity of the heart tones, it was decided to deliver the patient, which I did by means of Kielland forceps after making incisions in the cervix. The child had three loops of cord around its neck, but it was easily resuscitated. The patient had a severe postpartum chill and a temperature of 105°, but both mother and baby made a good recovery. Because of the evident intrapartum infection in this case, we immediately put in formalin for study, the placenta, which had a foul odor. Sections were made by Dr. Serbin, our pathologist, and we found clumps of bacteria not only in the maternal but also in the fetal portions of the placenta. On the fetal side, bacteria were found not only in the stroma of chorionic villi but also in the blood vessels of the villi. We thought we had made a discovery because not one of the men to whom the sections were shown knew of any one who had ever demonstrated bacteria in the vessels of chorionic villi.

A thorough review of the literature, however, disclosed the fact that three men had demonstrated bacteria in the vessels of chorionic villi. Schmorl in 1904 demonstrated tubercle bacilli in the villous vessels; Hellendall in 1906 demonstrated pyogenic organisms in the vessels; and Warthin in 1907 demonstrated tubercle bacilli. Under the microscope you will see an area showing bacteria in the

stroma of a villus and within the blood vessel of the villus. Other areas show bacteria in the decidua. There is, however, no evidence of inflammation in any of the sections.

I should like also to show a specimen of hydatidiform mole *in utero* which I removed from a patient who was referred to me because of an acute toxæmia. She was 12 weeks pregnant and had hypertension, albumin and casts in the urine, and œdema. She also had a mitral and aortic insufficiency and exophthalmic goiter with symptoms. She complained bitterly of a constant headache and persistent vomiting. She had had two children normally, both living. Most of the pathological anatomical findings were attributed by the patient to a previous severe attack of tonsillitis. Because of the severe acute symptoms she presented, it was decided to terminate pregnancy and perform sterilization. An abdominal hysterotomy was performed and on opening the uterus a few vesicles appeared. Since sterilization was to be performed anyway, a hysterectomy was done. The uterus corresponded in size and consistency to a 12 weeks' pregnancy, as you may see, and there had been no discharge of blood or vesicles at any time. The patient made an excellent recovery. Nearly all the abnormal symptoms disappeared quickly after operation.

DISCUSSION

Dr. Joseph B. De Lee: I would like to ask a question in connection with the case reported by Dr. Greenhill. A physician referred a patient to me from out of town, saying she had had an hydatidiform mole which he removed with the finger and followed it by curettage of the uterus. This physician suggested that I perform a hysterectomy as a prophylactic measure to prevent the development of chorio-epithelioma. According to the literature, he said, chorio-epithelioma occurs in from 33 to 50 per cent of all cases after hydatidiform mole, and in view of this high percentage of chorio-epithelioma following hydatidiform mole, this practitioner thought it would be wise to extirpate the uterus to prevent such an occurrence. I told him my opinion was different. I have had 20 or more cases of hydatidiform mole, and not one of them to my knowledge has come back with chorio-epithelioma, and I, of course, refused to take the uterus out in such a case.

I would be glad to hear the experiences of members of the society who have had cases of chorio-epithelioma following hydatidiform mole.

Dr. Emil Ries: I was called down state to testify as expert in a case where a doctor was accused of murder. The case centered around an abortion of a young woman who came to the doctor's office to consult him while aborting an hydatidiform mole. He sent her home and in the presence of the family he removed the hydatidiform mole. She died and was buried. Somebody caused an investigation. Her body was exhumed, the uterus taken out, and found clean. The uterus was presented to an expert in Chicago, the author of a textbook on gynecology, and this expert stated she could not have had an hydatidiform mole because she did not have chorio-epithelioma—the same mistake which has been mentioned here tonight. Because one case of hydatidiform mole is followed by chorio-epithelioma, it does not mean that every case of hydatidiform mole will be followed by chorio-epithelioma. Two of the experts in this case had read in books that chorio-epithelioma quite frequently developed in cases where there had been hydatidiform mole, and they agreed that the woman could not have had hydatidiform mole because it was not followed by chorio-epithelioma.

By showing up this erroneous conclusion the freedom of the doctor was secured at once.

Dr. Arthur H. Curtis read a paper entitled "The Diagnosis and Treatment of Sterility; A New Procedure."

BLOOD PRESSURE IN THE NEWBORN FOLLOWING NORMAL AND PATHOLOGICAL LABOR

Dr. Ralph Reis and Dr. Arthur J. Chaloupka contributed a joint paper (by invitation) entitled "Blood Pressure in the Newborn Following Normal and Pathological Labor." (See p. 206.)

DISCUSSION

Dr. Arthur H. Curtis: This paper bears the stamp of individuality and is worthy of great commendation. I am sure I voice the sentiments of the members when I say we have greatly enjoyed having Dr. Reis with us.

Dr. Joseph L. Baer: The work presented by Drs. Reis and Chaloupka represents a tremendous amount of painstaking effort and is therefore worthy of commendation aside from the actual merits of the results obtained. The question as to the practical value of their results will come out in a future series of cases on which they are going to work.

CHICAGO SURGICAL SOCIETY

Regular Meeting Held February 3, 1923, Dr. Frederick G. Dyas, Presiding

MEGACOLON IN CHILDREN

Dr. Vernon C. David read a paper entitled "Megacolon in Children." (See p. 197.)

DISCUSSION

Dr. Dean Lewis: I should like to say a word about the case which Dr. David reported and which I saw. This boy, 4 years old, had never had normal bowel movements. He had worn a diaper because of a continuous discharge from the rectum. When I saw the X-ray picture, I thought that a good deal of the obstruction was due to the falling forward of the upper part of the sigmoid at the ampulla, and if I could resect that I might enter the abdominal wall. I resected the sigmoid and sutured with a modified Mikulicz, suturing the line extraperitoneally, and opened it on the second day. Dr. David started on the valve formation, which was about the position of the mucocutaneous junction or a little higher. The operation was done in January, 1921. I closed the colostomy on October 28, and the boy has been having normal bowel movements since. I think he has had daily evacuations of the bowel without any apparent obstruction. He has been on a regulated diet. I supposed the valve was the primary etiological factor in the megacolon, and that the fixation of the colon to the abdominal wall to prevent falling forward of the sigmoid at the ampulla had something to do with it.

I operated on another case 7 years ago which had been seen by Dr. Senn. At that time the patient had a fairly large bowel. She was 38 years of age, and gave a typical history of megacolon. An interesting thing was that it was associated with a neuroenteric cyst, the size of a grapefruit, in the hollow of the sacrum, and containing cerebrospinal fluid. In this case I extirpated a part of the cyst. I opened the cæcum on account of obstruction. It is now 7 years since the operation was done. I saw her on October 28, last. She has to take enemas to evacuate the bowel; otherwise she is fairly comfortable without any great dilatation. She has never had regular bowel movements since the operation. In her case I did an end-to-side anastomosis between the ascending colon and the rectum. If I remember correctly, I took out the sigmoid and transverse colon and did an end-to-side anastomosis, but as I have said, she has never had a normal evacuation of the bowel. However, she gets along fairly well with the use of enemas. No valve formation has been demonstrated in this case.

Dr. E. Wyllys Andrews: The type of congenital deformity Dr. David spoke of is closely allied to the ordinary imperforate anus. In imperforate anus we find a blind pouch below and above another fold; sometimes these are 3 or 4 centimeters away from each other, with a large bridge of tissue which has to be spanned somehow. In such a case one can make a puncture with the bistoury to find the length of the muscle or other tissue from the blind pouch below to the pouch above, and introduce a tube.

The abnormity Dr. David has mentioned is not so very rare, as I have seen five or six such cases.

Dr. John Nuzum presented a paper on "Experimental Production of Carcinoma in a Dog's Breast."

Dr. A. J. Ochsner read a paper on "Cancer Infection."

CHICAGO SURGICAL SOCIETY

Regular Meeting Held April 6, 1923, Dr. Frederick G. Dyas, Presiding

SYPHILIS OF THE STOMACH

Dr. Gatewood: It is not very often that we have the opportunity of following up our cases of syphilis of the stomach. As it happens, there is in town today a man, who, I feel quite sure, had syphilis of the stomach. I am glad to have the opportunity of presenting him tonight. This man consulted my brother 3 years ago last August, giving a history, at that time, of losing weight for 6 months. He then weighed about 108 pounds. The most important point in his history was vomiting immediately after meals. He had gotten so that he could take but little when he swallowed, 5 or 6 ounces being the maximum. He was on an entirely liquid diet. Physical examination at the hospital showed very little except marked emaciation. The laboratory findings were these: the Ewald showed no free hydrochloric acid, total about 14; no blood in the stomach contents or stools; hæmoglobin 62 per cent with the blood picture otherwise negative. X-ray showed a very marked defect in the stomach which I will show you on a slide, and this defect involved most of the stomach wall. The Wassermann was 4 plus. He gave no history of an initial lesion. He is the father of four children, and there is no history of miscarriages. The findings, then, were achlorhydria, a stomach defect, an inability to eat. He had obstruction in the duodenum beyond

the outlet, somewhere in the retroperitoneal portion. This was not marked and was only a part of the clinical picture. A pre-operative tentative diagnosis of syphilis of the stomach was made upon the deformity and upon a 4 plus Wassermann. At that time it was not deemed advisable to continue the therapeutic test for any length of time, because in spite of all that could be done he continued to lose in weight. I operated on him, doing a gastro-enterostomy. I found a stomach which at no place was wider than my three fingers. It was œdematous and had a glassy appearance throughout. He had stellate scars on the liver with the typical picture of syphilis of the stomach.

After operation he was given the benefit of antiluetic treatment, and he has gained from 108 pounds back to 140, his normal weight being 132 pounds before. He is doing the work of a section hand on a railroad and apparently is in excellent health.

URETHRORECTAL FISTULA

Dr. T. J. Sullivan, Sr.: A urethrorectal fistula is a condition that is not often met with in general surgery for most of these cases go to the genito-urinary man. The reason for presenting this operation tonight is to show my modification of an old principle in treating such cases. I recognize the splendid work by Hugh Young, published in Surgery, Gynecology and Obstetrics, and by Dr. Harvey B. Stone later on, published in the *Journal of Urology* in 1917 and 1921 respectively, reporting a new method of operating which differs from anything previously shown and giving good results in fourteen cases.

The technique which I have worked out is based upon a principle which was described in 1902 by Paul Segond. I shall say nothing about operations performed previous to that time.

In dealing with complete laceration of the perineum in the female, Paul Segond maintained that a better operation can be done by dividing the scar, passing up on the rectum and dealing with the torn rectum down to the verge of the anus, thus shutting off contamination of the wound and closing the perineum over the rectum. I have often used this method, and I applied the same principle to this case and succeeded in securing primary union.

Urethrovesical fistulæ are in many cases the result of operations for the removal of vesical calculi. That was the cause in this patient who had been operated on more than 20 years ago. Such fistulæ may also follow operations upon the prostate. Severe trauma and infective inflammations may also cause these fistulæ. The first cause mentioned, however, is the most common.

The first step in operating on these cases is preliminary cystotomy. In our case there was a preliminary cystotomy was performed and drainage of the bladder instituted to maintain a clean field. When this was done the patient was put in the Trendelenburg position and a stab was passed through the urethra and into the bladder. A cross incision was made to expose the perineum; the rectum was uncovered and drawn down as it is in the operation described by Paul Segond. This makes it possible to dispose of the fistula in the rectum and to have a clean field attached so as to build the perineum afterward.

SYPHILIS OF THE STOMACH

Dr. Karl A. Meyer read a paper entitled "Syphilis of the Stomach." (See p. 127.)

DISCUSSION

Dr. W. A. Brams: There are a few points in connection with syphilis of the stomach to which I desire to call attention. These points are best illustrated by citing two cases, one of which shows the advisability of giving very intensive syphilitic treatment in cases of supposedly inoperable carcinoma of the stomach. This patient was observed on the service of Dr. Bensaude in Paris, the patient being a man 55 years of age, who suddenly developed copious hæmatemesis; vomited about a pint of blood without ever having had any gastric disturbance. For 2 years following that he had vague digestive symptoms, consisting largely of nausea, constipation, and loss of about 25 pounds in weight. Two years after the first hæmatemesis he had another attack. Later he was taken to the hospital; the abdomen was rigid and no palpation could be made. Bleeding was profuse so that no gastric analysis could be made. Eventually a mass was felt in the abdomen and a diagnosis of carcinoma was made; but the condition was considered inoperable, and as a last resort mercury was given to him by injections. The condition cleared up. An instructive part is the X-ray examination of the stomach right after hæmatemesis. The X-ray examination before treatment showed complete absence of the pyloric part, and after specific treatment, lasting for several weeks, the pyloric portion of the stomach gradually returned, according to the fluoroscope, and after a few months the pyloric portion was complete and showed normal motility. We received a letter from him 2 years later in which he stated he was in good health and had gained 50 pounds in weight and had no more gastric distress.

While the case may not be considered as proved syphilis of the stomach, the probability is in favor of that diagnosis.

In another case a diagnosis of syphilis was made but it was not syphilis. The patient, a male, had suffered from epigastric pain after meals for 8 months. He was a waiter by occupation; he had a mass in his abdomen and a 4 plus Wassermann. He, too, was considered as having carcinoma of the stomach at first, and in 5 days died. Autopsy showed a stomach which had five superficial ulcerations which at first were considered syphilis. But on making a cut section of the stomach wall it was at once seen that the case was not syphilis. The submucosa was not thickened. None of the changes

described here were present. Vascular involvement was not present. Pan-phlebitis and pan arteritis were absent. There was not even an extensive lymphocytic infiltrate.

A careful review of the literature was made and of all cases reported in the domestic and foreign literature, and we selected 135, which we considered reliable and with sufficient information upon which to base a presumptive diagnosis of syphilis. Of these 135 cases, 14 were anatomically proved, and the 2 reported tonight makes a total of 16.

There are four varieties of gastric syphilis, depending upon the underlying pathology: the ulcerative type; tumor or gumma; the leather-bottle type, and the stenosing type. It is hardly necessary to go into more detail. In the stenosing type the pylorus and cardia may be involved in the same individual.

In studying the symptoms of these 135 cases it was found that pain was the most important symptom of all. It was present in all but 3 cases and came on after meals. There was a marked subacidity; in 93 reports there was marked anacidity or subacidity. Marked emaciation was present in 88 per cent. the average loss of weight being 35 pounds. The fact that the patients had so much emaciation and anæmia leads to the suspicion of their having syphilitic cachexia, and not a malignant cachexia. Eight cases showed evidence of lues, and in 96 the Wassermann was positive. In 9 additional cases there were undoubted signs of lues. Sixty per cent of the cases were clinically cured with specific treatment; in 30 per cent there was marked improvement, and in 7 per cent of the cases there was failure. Einhorn reports a case of anacidity which returned to practically normal after treatment. In one case I mentioned at first there was a return of the pylorus to normal as seen on X-ray examination.

The X-ray reports vary as to the findings. One cannot say that there is a definite picture of syphilis of the stomach on the X-ray plate. The nature of the findings will depend upon the nature of the pathology. If there is a tumor or a gumma it may look like a carcinoma, and if there is stenosis it will look like a stenosis.

Other less important symptoms are hæmatemesis, vomiting, constipation, and tenderness, and enlargement of the liver in the anatomically proven cases was found in the majority of them.

Dr. Roger T. Vaughan: It was my privilege to see this pyloric mass resected by Dr. Meyer, and I examined it immediately after removal. The society should not get the impression that Dr. Meyer recommends excising syphilis of the stomach. Not at all. At operation he found a mass in the pyloric end of the stomach with the glassy œdematous appearance of the serosa which Dr. Gatewood also noted in his case. The clinical findings were those of well-marked pyloric stenosis.

The diagnosis lay between carcinoma and syphilis of the stomach. We knew the woman had systemic, gummatous syphilis. She also had a large mass at and proximal to the pylorus and had enlarged glands along the lesser curvature. There was some hesitancy in deciding whether resection should be attempted or merely a gastro-enterostomy. Dr. Meyer asked my opinion and I agreed that it appeared logical to take it out. After the mass was resected I examined the opened surface of the gross specimen. The submucosa was markedly thickened and infiltrated. The ulcers had ragged margins and a granulomatous base. There were no raised, hard, infiltrated nodular edges as we see in epitheliomatous ulcers. The entire mass appeared to be a granuloma, but no caseous foci could be found. There was no reason to believe the patient had tuberculosis and we *did* know that she had active syphilis.

If this specimen is syphilis of the stomach, it is the only fresh case that I have seen; and if it is not syphilis, I do not know what it is. Certainly the microscopic findings are also highly suggestive even though the spirochæta has not been found.

I have seen a number of patients on whom there has been made the clinical diagnosis of syphilis of the stomach. When such patients recovered, the correctness of the diagnosis has usually remained a matter of dispute, but if they died and were autopsied they nearly always proved to have carcinoma of the stomach. A positive Wassermann is present in 10 per cent of the cases of carcinoma and ulcer of the stomach. Patients with carcinoma of the stomach may improve for a time under such tonics as arsenic and mercurials and appropriate dietetic management. A patient with syphilis of the stomach can also improve under routine ulcer treatment, much as does a peptic ulcer, and the recovery of patients with peptic ulcer is not hindered if arsenic or mercurials are added to the usual ulcer treatment.

It has seemed to me hitherto that clinical diagnoses of syphilis of the stomach have been by no means well founded.

I have seen no case in which has been applied the ultimate test to the diagnosis of syphilis of the stomach, namely, the finding of the treponema. It was not found in the case Dr. Meyer operated on nor in the case of Dr. Brams. It has only very rarely been found in cases of syphilis of the stomach, so far as I am familiar with the literature, and must be differentiated from spirochæta dentium, which is occasionally a surface saprophyte in achylous stomachs. The treponema is hard to find. In Arthur Curtis' case[1] endarteritis was a striking finding as well as the miliary gummata which we see here in Dr. Meyer's case, but Dr. Curtis, too, was unable to find the treponema.

If this case reported by Dr. Meyer is not one of syphilis of the stomach, I do not know what it is. Perhaps it is not necessary that the treponema should be found in order to confirm the diagnosis, since the treponema has also not been found in those cases which have come to autopsy. In view, however, of our present inability to apply this

[1] J. Am. M. Ass., 1908.

ultimate test with success to cases diagnosed gastric syphilis, scientific caution would appear to demand that we make this diagnosis tentatively and with the mental reservations which our present lack of confirmatory evidence makes necessary. In order to administer arsenical or mercurial preparations to gastric ulcer cases, however, only a reasonable suspicion of the presence of syphilis should be needed. Therefore, a positive Wassermann test or other signs of syphilis would appear to justify these additions to standard ulcer management; but a successful outcome subsequently does not prove that the gastric lesion so treated was syphilis.

Dr. Gatewood: I have seen four cases of syphilis of the stomach which were as typical as the one I have described. The difficulties in doing a gastro enterostomy in these cases are considerable. On account of the marked œdema and submucous thickening a clamp should rarely be put on the involved portion of the stomach, making it necessary frequently to do a gastro-enterostomy without a clamp. This seems to make no difference because in each of these four cases the patient made a good recovery without leak. All four cases received anti-syphilitic treatment after operation. Three of them at the present time are markedly improved or well, one having been operated on 6 months ago, one 3½ years ago and the third about 5 years ago. I have no recent report upon the fourth case.

Dr. Carl B. Davis: I wish to report a case in which the patient was turned over to the surgical side with a diagnosis of cancer. After the abdomen had been opened a small, constricted stomach was seen that was quite suggestive of a condition known as "leather bottle." The possibility of syphilis of the stomach was discussed with the internist who was present at the time of the laparotomy. There were a number of slightly enlarged glands in the gastrohepatic ligament. One of these was removed for microscopic examination. It was impossible to decide at operation whether the linitis plastica was a carcinomatous infiltration of the entire stomach or whether the condition was syphilis.

Microscopic examination of the gland showed carcinoma.

Dr. R. W. McNealy: I should like to ask why the treponema cannot be found. We know that it is found in other tertiary lesions. I would like to ask the authors if they have any reason to suggest for not finding the treponema.

In looking over the literature of blood-vessel surgery, I have found several instances in which spirochæta have been found at the vasovasorum in the vessels and demonstrated by several men.

Dr. Meyer (closing): There have been reported cases in the literature in which the treponema pallidum have been found in lesions of the stomach. J. W. McNee in the *Quarterly Journal of Medicine*, April, 1922, reports and demonstrates the finding of spirochætæ in a resected ulcer of the stomach. Wile, of Ann Arbor, also mentions the finding of these organisms in the stomach mucosa. The possibilities are that as more cases are examined by serial sections, an increased number will show the presence of these organisms.

In answer to the question relative to the infrequency of the spirochætæ in gastric lesions, it may well depend upon the action of the gastric juice.

The reason for the extensive resection of the stomach in this case was due to the actual organic obstruction. I had observed this patient under the fluoroscope and during the period of three-quarters of an hour, no barium passed through the stomach into the duodenum.

It may well be that more cases of syphilis of the stomach are about than are ordinarily diagnosed. We should, however, not become too enthusiastic and diagnose every case of gastric ulcer showing a positive Wassermann as one of syphilis of the stomach. If we investigate our cases from an anatomical and pathological standpoint, we find that many cases of peptic ulcers, diagnosed as syphilis, are callous ulcers and have no luetic basis.

Dr. Charles Davison read a paper entitled "Adhesions of the Ascending Colon Simulating Chronic Appendicitis." (This article will appear in a later issue.)

BOOK REVIEWS

A CRITIQUE OF NEW BOOKS ON SURGERY

THE busy practitioner, and no doubt in many instances the specialist, being so engrossed with his daily work, loses sight of many of the more interesting phenomena, from a physiological standpoint, which take place. He therefore loses not only a very important factor in his own viewpoint, but furthermore loses his scope of medical vision.

It is manifestly impossible for a busy man to keep himself informed upon all the newer advancements made in the basic branches of medicine. Another factor which no doubt further confuses the busy man is the more or less constant change of opinion on bacteriology, physiology, and the like. He is told one thing today, which is disputed tomorrow, and likely disproved on the third day. No doubt many men lose their courage in trying to keep abreast of medical progress and science as applied to medicine.

It is, therefore, of great interest to read the re-edition of the little volume by Short.[1] This volume deals with the newer physiology in surgical and general practice. In the first edition it was the author's intention to bring to the clinical man those new facts as applied to physiology, which had been more or less definitely established and proved, and which could be used as a basis for the study of clinical cases. In the present, which is the fifth edition, the author has in no way altered his position. There have been three more chapters added, and two chapters from former editions have been dropped out.

This little volume affords the most interesting reading, because it places before the reader's mind in a very logical and pleasing manner, many of the basic principles from a physiological standpoint which confront the practitioner, and which give him a distinctly new line of vision and open new avenues of thought. In contrast to most books of this nature, the subject matter is presented in a most interesting fashion, in such a way that one may read hours without becoming fatigued or bored.

The author does not attempt to present anything new to the profession, but simply to compile from the enormous amount of work done and the literature produced, those facts which he thinks are more or less stable and new, and which will be of value to the reader.

As an illustration, the first chapter, which deals with the physiology of muscular exercise brings many interesting points to the reader's attention, which, although they give us no basic explanation for many processes which take place, yet open up avenues of thought and stimulate in the reader's mind that which is more necessary than information—namely, the ability to think.

Furthermore, in the chapter devoted to the dietetic factors in causation of appendicitis, I do not believe the author attempts to state that appendicitis is caused by dietetic errors; nevertheless, after reading this chapter, one is convinced of certain rather unusual things and with this opinion as a basis for further thought the reader will be much the more enlightened.

The author does not attempt to cover the entire field of physiology, but, as stated in the preface, simply brings to the attention of the practitioner certain new phases of the newer physiology as it pertains to surgery and medicine.

The book can be heartily recommended to those men who wish to learn to think anew.

THE manner in which a living organism defends itself against destructive processes, has been a study which has always confronted the medical profession. As much as we may know about immunity at present, we must confess the question is more or less answered by calling certain intangible, vague things by names and assuming that they perform certain specific functions.

This statement is not made to belittle in any way many of the processes which have been discovered by the scientists. There is no doubt that many of these processes do take place in some manner or form, and that we must accept them at the present time until they are disproved. Nevertheless, it is very apparent that this whole subject must be most confusing to the student, even though he may have worked with the subject, both in its laboratory aspect and from clinical application, and he very frequently becomes lost in this labyrinth of cursory facts.

The presentation of this subject in a form which is simple, concise, and clear, is certainly invaluable to the student of medicine, and to anyone who wants an introduction to the subject. To the reviewer's mind, this is ideally met with in the little book by Jean Broadhurst.[2] It was a great pleasure to the reviewer to read this book from cover to cover, and there is no doubt in his mind that it is

[1] The New Physiology in Surgical and General Practice. By A. Rendle Short, M.D., B.Sc. (Lond.), F.R.C.S. (Eng.). New York: William Wood & Co., 1922.

[2] How We Resist Disease; An Introduction to Immunity. By Jean Broadhurst, Ph.D. Philadelphia and London: J. B. Lippincott & Co., 1923.

probably the best presentation of the subject which is brief, with which he has come in contact. The subject is discussed in stages, beginning with bacteria, their entrance into the body, their life cycle as affecting active and passive, immunity toxins and antitoxins, agglutinins, precipitins, opsonins, lycins, etc.

The subject matter of each chapter prepares the reader for a greater comprehension of the subsequent discussions. The value of this book lies not in presenting anything new, but presenting those more or less established principles in a manner which is understandable, readable, and clear. The book is invaluable to the student of medicine, to the nurse, either in training or in practice, and to a large group of medical men who should read it, not only from force of necessity, but for the satisfaction of acquiring certain definite knowledge.

THERE is considerable question in the reviewer's mind as to the value and necessity of a textbook of surgery. Many surgical teachers believe such a book is not only useful but indispensable. This attitude is no doubt justifiable so long as surgery is taught in many universities as it is at the present time. Nevertheless, it seems that in many medical schools a decided change is taking place in surgical pedagogy, and the reviewer is inclined to believe that sooner or later teaching from textbooks will become obsolete.

However, so long as students are taught the subject by getting their information from books, a textbook of surgery will be a necessity. In spite of the fact that there are many textbooks of surgery in the hands of the medical profession, some exceedingly well written, some mediocre, and some decidedly poor, it appears that the ideal book for teaching has not yet come to light. The fault probably lies in the fact that each surgical teacher has his own peculiar method of approaching the subject and does not confine his literary efforts solely to his teaching instinct, but tries to cover his subject in a more or less complete fashion such as would appeal to his own mind.

The re-edition of *Practice of Surgery* by Howard,[1] is, to the reviewer's mind, one of the best presentations of the subject we have today. The subject is covered in a very complete manner, and special emphasis is placed upon the fundamentals. The author states, in his preface to the first edition, that this work is the result of the request of many students to prepare a book which embodies so far as possible the surgical teaching given by the author in the London Hospital. There is no doubt but what he has accomplished his purpose.

In this, the third edition, the book has been brought up to date. The section on "Injuries of the Nerves," has been largely re-written. There have also been revisions made in the chapters devoted to the stomach, duodenum, and colon, in which he includes roentgenographic methods of diagnosis, his descriptions being brief but lucid. In many instances, especially in the discussion of regional surgery, the author tabulates his subject matter in such a fashion that one can, at a glance, grasp the salient divisions. This is very useful to the student, since these facts stand out as the important parts of the subject discussed and he can fix them in his mind much more readily. It obviates the common objection to most textbooks, namely, that the student reads the discussion and fails to grasp the essentials.

At the close of many chapters the author leaves blank pages for notes, which the student may insert from time to time thus completing his subject; a very desirable feature, in the reviewer's mind, for it enables the student to keep his notes with the original textbook.

Whatever opinion one may have regarding textbooks of surgery for teaching purposes, one must concede the fact that this book is unusually well written, and that the subject is so well presented that even the student must of necessity grasp the important points. The book is also of decided value to the practitioner who wishes information upon surgical topics without resorting to any unusual efforts. To the reviewer's mind, it is one of the best books upon the subject which is in our hands today.

THERE is no question but what the nurse who has a fairly comprehensive idea of surgery is more competent to take care of her surgical patients than she who has not. This knowledge should be general, comprising not only a knowledge of etiology and pathology, but symptoms and treatment as well, since with such knowledge, she can co-operate with the surgeon in charge much more efficiently and is capable and able to detect symptoms which she alone is in a position to observe.

A volume, therefore, which comprises those essentials of general surgery which would present to the nurse's attention these facts, is no doubt indispensable. McDonald, in his little *Manual of Surgery*[2] has accomplished this purpose in a satisfactory manner. The varied subjects are taken up very briefly but nevertheless the essential points are brought to the reader's attention in a simple, concise manner, giving the reader those facts which are basic and important.

Errors will creep into almost any work, and it might be well to call attention to the statement made under the paragraph entitled "Peripheral Nervous System," where it is stated that a paralysis of the fourth cranial nerve causes drooping of the upper eyelid.

This volume is written essentially for the nurse, and it fulfills its purpose adequately.

J. A. Wolfer.

[1] [illegible] Howard. C. B. [illegible] 1914. [illegible] Philadelphia and London. J. B. Lippincott Company.

[2] A Manual of Surgery for Student Nurses and for Those Interested in the Care of the Sick. By Archibald Leete McDonald, M.D. 2d ed. rev. Philadelphia and London. J. B. Lippincott Company. 19[illegible]

THE fourth edition of this book was published in 1912, under the supervision of the original author, Sir F. W. Hewitt.[1] During the intervening 10 years the advance in the science of anæsthesia has made such progress that the entire text has been rewritten. This revision with the addition of that which is new upon the subject is presented in a concise, well arranged manner. The volume is of particular value to the medical student as well as to the specialist in anæsthesia because the interesting and informative subject matter is based upon years of clinical experience. Chapter IX deals especially with the pre-operative considerations—including the psychic element so largely neglected. There can be no controversion to a patient's truthful description of a crude induction of anæsthesia. The book is up to date with the exception of the experimentation of ethylene, which is of too recent a date to have been included. This edition is a valuable text and reference book upon the subject of anæsthesia.

A. L. Part olomew.

IN the introduction, the author expressly states that this book[2] represents his own observations and research and is not a compilation of the opinions of others. In this respect it is refreshing, yet this same virtue makes it necessarily rather incomplete. The book is divided into sections, in which various diseases of the bones and joints are considered.

In the first section general considerations are taken up. The various structures entering into the formation of bone, and their reaction to inflammations of various kinds are studied. The author lays particular stress on the idea that the real site of all inflammation is in the marrow of the bone, and particularly in the lymphoid marrow. In the joints, the susceptible structure is the synovial membrane. All the other structures play only a passive part. In this section the subjects dealing with the healing of fractures, ankylosis, bone grafts, and arthroplasty are also considered, briefly, not to say sketchily.

In the second section, devoted to "Acute Osteomyelitis and Arthritis," the idea that the marrow is the tissue chiefly affected is further elaborated. The author takes the stand that trauma plays a very slight rôle in these conditions.

In section three "Chronic Osteomyelitis" is considered. In this many of the rarer forms, osteomyelitis fibrosa, leontiasis ossea, Paget's disease, syphilis, and rickets are taken up.

Section four is worthy of special notice. It is entitled "Chronic Arthritis." The author calls attention to the confusion in the classification of the chronic arthritides, and proposes to simplify it by dividing them into two great types which he calls simply the first and second great types. The first great type is that in which "there is a proliferative inflammation in the synovial membrane and in the bone marrow, with a resulting rarefaction or death of the bone and a perforation or death of the articular cartilage," i.e. a destructive arthritis. This includes tuberculous, streptococcic, and probably all the bacterial arthritides. The second great type is the proliferative type with new bone formation at the joint line. Further to simplify matters the author takes the ground that the first type practically always originates in the tonsils, deep urethra prostate, or seminal vesicles; the second type always originates in the alveolar process, or rather is associated with alveolar necrosis which may furnish a portal of entry.

The book is decidedly unorthodox in many conclusions, and being unorthodox is worthy of careful consideration. It is especially good for the amount of pathological study, that is for the careful study of the microscopic pathology of bone and joint conditions. The illustrations of these microscopic specimens are good. Treatment is rather scantily considered. Taken as a whole the book is rather hard reading but shows the evidence of study, and should stimulate thought, which is the hallmark of a good book.

B. H. Moore.

THE *Manual of Surgical Anatomy*[3] by Beesly and Johnston is an extremely comprehensive textbook. Surgical anatomy is really after all only a review of those parts of anatomy which a surgeon must know. From this standpoint, the choice of material is excellent. Especially notable is the omission of the enormous mass of detail descriptive of ligations and amputations which encumbers so many of the works on surgical anatomy. On the other hand, the anatomy of the newer fields of surgery, especially joint surgery, is thoroughly treated.

The value of such a book is largely dependent on the illustrations. This book contains 166, many of which are semidiagrammatic and are for the exposition of special points. All of the illustrations are of the highest quality, and there are many plates. Many are modified from Cunningham's *Anatomy*. The authors have yielded to the desire to depict the unusual instead of the commoner forms of pathology, as exemplified by the roentgenogram of a case of tuberculous dactylitis in a child. The many plates of bones and joints in children are an excellent feature. Epiphyseal lines and centers of ossification are well shown, both in the normal and associated with fractures.

Unfortunately, the book is marred by too much technical description of surgical operations. Furthermore these sections abound in actual misstatements of facts. For instance, the method of performing a gastro-enterostomy, described on pages 302–3, is hardly the usual one. The site for the anastomosis is "preferably the most dependent portion of the

[1] Anæsthetics and Their Administration. By the late Sir Frederick W. Hewitt, M.V.O., M.A., M.D., 5th ed., edited by Henry Robinson, M.A., M.D., B.Ch. London and New York: Oxford Medical Publications, 1922.

[2] Inflammation in Bones and Joints. By Leonard W. Ely, M.D. Philadelphia and London: J. B. Lippincott Company, 1923.

[3] A Manual of Surgical Anatomy. By Lewis Beesly, F.R.C.S. (Edin.), and T. B. Johnston, M.B., Ch.B. New York: William Wood & Co., 1923.

greater curvature"!! Atomy is also given as one of the indications for this operation. Another surprising statement appears on page 345, in a discussion of implantation of the ureters into the colon. "It might be supposed that the introduction of the ureters into a septic tube would lead to an ascending infection of the urinary tract, but, provided that urine, ureters, and kidneys are healthy there is no risk of such an occurrence." Again, on page 315, anastomosis of the gall bladder to the colon is recommended for common duct obstruction, and it is further stated that common duct obstruction causes a dilatation of the cystic duct.

However, the main part of the text, the anatomical descriptions, cannot be too highly praised. They are characterized by a brevity which might well be adopted by other anatomists, and at the same time there is no sacrifice of clarity. This fact alone should assure the success of this *Manual*. Finally it may be noted that the indexing is thorough and complete. EDMUND ANDREWS.

IN 1904, the prosectors of the faculty of the University of Paris began issuing a series of small volumes covering the operative technique of surgery in different parts of the body. Doctors Labey and Leveuf[1] have recently brought forth the fifth edition of the book covering surgery of the lower extremity. This little book is divided into three parts: first, surgery of the bones; second, surgery of the joints; third, surgery of the tendons, veins and nerves. In Part 1, the technique of the different forms of osteotomy is described as well as the technique used in introducing the Steinmann nail. Open treatment of fractures is given much attention, and the many types of operation, especially those on the femur, are given in detail, but the indications for operation are not mentioned. The treatment of patellar fracture is well illustrated. In part 2 we find a description of operations on joints, including drainage, resections, and arthroplasties, much attention being bestowed on the foot joints. In Part 3, surgery of the tendons is meagerly covered, as is also the subject of vascular lesions. In the section on nerve surgery, we find a description of operations on the important nerves of the lower extremity. The illustrations are clear and instructive, and while the information on the subjects covered is scant, it is definite and the book might well be used as a ready reference for the embryo surgeon. KELLOGG SPEED.

THIS single volume[2] is the work of two international authorities on orthopedic surgery. One is the leader in orthopedic thought throughout the world; the other, one of the leaders in American orthopedic surgery. Both are renowned teachers and thorough students. The book is authoritative, practical, and a valuable work for the student, the general practitioner, and the orthopedic specialist. It is too technical for the average student.

The authors have not attempted to make the work of an encyclopedic nature, and have, therefore, omitted methods which they consider obsolete or ineffectual. Much discussion of discarded methods is happily omitted. They have used their own wide personal experience as a basis of their discussion and it is of great value that each author gives his individual thought on many subjects,—this to be contrasted with that of the co-author. The methods of other authors are given and are well illustrated in many cases.

The method of teaching used is fundamental and employs the principle of association in an endeavor to use the process of thinking instead of the cultivation of memory.

The scope of orthopedic surgery as defined in this book is divided into six groups: (1) joints and their affections, (2) bones and their affections including ununited and malunited fractures, (3) disturbances of the neuro-muscular mechanism, (4) congenital deformities, (5) static and other deformities, and (6) the principles and details of apparatus.

In studying the numerous illustrations, one recognizes many old acquaintances seen in the former publications by the same authors. This is especially true in the chapters on scoliosis, infantile paralysis, and stiffness of joints. Many reproductions from Bradford and Lovett's book are used.

The authors have drawn freely from the works of numerous surgeons and have reproduced many classical operations, viz., arthroplasty of the knee-joint by Putti, operation for loose bodies in the knee-joint by Henderson, the Edwards operation to reconstruct internal and external lateral ligaments of the knee-joint, the Hey-Groves operation for ruptured crucial ligaments of the knee-joint and the Smith-Peterson operation on the sacro-iliac joint.

The Everidge method of aiding the patient's will power in moving septic joints by means of graduated passive movement is illustrated very well and is a valuable supplement to the practice of Willems. The descriptions of the mechanics and measurements of braces are very good. An excellent brace for round shoulders is illustrated but not described.

The frequent paragraphs on anatomy and physiology are excellent introductions to several chapters. The gross and microscopic pathological sections illustrated are excellent. PHILIP LEWIN.

[1] CHIRURGIE DU MEMBRE INFÉRIEUR. By Georges Labey and Jacques Leveuf. 5th ed. rev. Paris: Masson et Cie, 1923.

[2] ORTHOPEDIC SURGERY. By Sir Robert Jones, K.B.E., C.B., and Robert W. Lovett, M.D., F.A.C.S. New York: William Wood & Co., 1923.

AMERICAN COLLEGE OF SURGEONS

HEALTH SITUATION AND MEDICAL SCHOOLS OF LATIN AMERICAN COUNTRIES

By OSCAR DOWLING, M.D., New Orleans, Louisiana
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I. HEALTH SITUATION

DURING the 1923 cruise of the American College of Surgeons facts were gathered concerning the health situation in fifteen cities of seven South American countries: Cartagena, Colombia; Caracas, Venezuela; Rio de Janeiro, São Paulo and Santos, Brazil; Buenos Aires, Argentina; Montevideo, Uruguay; Santiago, Valparaiso, Antofagasta, Mejillones, Iquique, Arica and Tacna, Chile; and Lima, Peru. Conditions in Havana, Cuba; Port of Spain, Trinidad; and the Canal Zone were also noted.

Figures show about the same percentage of tuberculosis, typhoid, smallpox, syphilis, gonorrhœa, and malaria as with us (except on the dry west coast and in a few places which have been drained). Considerable trachoma and leprosy exist, and in a few places, hookworm disease. The endemic tropical diseases are comparatively negligible as compared with those with which we are familiar. With the exception of a few cases of yellow fever in two cities of Brazil, where active measures were being taken similar to those followed in New Orleans in 1905, there was no plague, no cholera, and no yellow fever. Incidentally, it may be of interest to add that they have had no plague in Rio de Janeiro since 1910, and no yellow fever since 1907; in Buenos Aires, no plague for 5 years, and no yellow fever for 30 years. This is excellent evidence of effective control measures. The facts justify the conclusion that the health situation in the various countries is very similar to our own.

In some communities a large per cent of the babies die under one year of age. Commenting on this one of the leading papers said: "Ignorance is the chief cause of infant mortality. To control this, well-prepared nurses of intelligence and initiative are necessary to teach the mothers and the public." In almost every place visited the supply of good milk is very limited. Were this provided, with teaching by the intelligent trained nurse, the death rate among infants would be materially reduced.

Some of the outstanding impressions concerning communicable diseases are: Extreme precautions to prevent smallpox; compulsory vaccination, and maritime quarantine against this disease with strict enforcement of regulations. Other contagious diseases are controlled more or less effectually by methods similar to those in effect in the United States. The value of educational work and demonstrations of control are emphasized.

In Port of Spain, Trinidad, epidemic diseases are divided into dangerous and non-dangerous, and the dangerous cases are handled exclusively by the Government. In case of plague the house is burned and the owner is compensated.

Brazil is spending $2,000,000 in a hookworm eradication campaign, which appropriation is matched or added to by the Rockefeller Foundation.

It was interesting to note that in thirteen cities the water supply was brought from a distance—from the mountains, pure and wholesome, or from artificial lakes. The water supply of Rio de Janeiro comes from the mountains forty miles distant; sheds protect the water, making treatment unnecessary. The supply for Buenos Aires comes from the river fifteen miles above the city. The system is the same as that in New Orleans. In Lima, Peru, the water is from springs and is settled, filtered, and chlorinated; the system is now being rebuilt. In the little city of Mejillones, Chile, the water is condensed and sold by the railroad shops at ten cents for five gallons; in Iquique, Chile, a city of 40,000, the water is wholesome and abundant but expensive; they are hoping soon to have free water.

Modern methods of waste disposal were found in several cities. In Rio de Janeiro, sewage is treated chemically before it is emptied into the sea; in Buenos Aires the sewage is carried fifteen miles down the river and emptied below low water mark.

Incinerators are used to dispose of garbage, which is collected in covered wagons and carts. In Panama, under the direction of Dr. Henry Goldthwaite, the incineration of garbage, except certain light waste, has been abandoned because of expense and odors from the plant, and they now dump the garbage for filling purposes, The garbage is sprayed, to saturation almost, with a larvacide and then covered with a layer of bags or old carpets and over all three feet of earth. This earth is sprayed for ten days. By this means objectionable odors are avoided, flies do not breed, and rats are not harbored. This method has proven satisfactory and economical. It is stated in the report of the Spe-

cial Panama Canal Zone Commission, made to the Secretary of War: "We know of no city in the United States that is as clean as Panama, nor where the flies and mosquitoes are so scarce. . . . The alleys and yards are as clean as the main streets." These same conditions apply in general to the Canal Zone.

In Santos, Brazil, a city of 40,000, every house has water, sewerage facilities, gas, electricity, and a telephone. This is the more striking when it is remembered that 70 per cent of the population is engaged in manual labor.

Dairy cows must be tuberculin tested in Havana, Panama, Rio de Janeiro, Buenos Aires, Antofagasta, and Lima. The entire time of the force in one laboratory of Rio de Janeiro is given to examining and testing of milk. Port of Spain, Trinidad, uses a large amount of condensed and powdered milk. The rules of a private dairy in one city are so strict that a visitor is not allowed to enter the dairy until his shoes are washed in an antiseptic solution.

I was impressed with the need for a revision of maritime quarantine regulations. The civilized countries of the world have put into practical effect scientific discoveries for the control of certain communicable diseases. Many great ports have been freed from bubonic and other plagues and, in justice to them and because of the need of commercial expansion, there should be international quarantine laws which would take into account the convenience of the traveler and the extension of social and commercial relations. There should also be provision whereby public travelers may be assured that the ship or train is supplied with potable water.

II. MEDICAL SCHOOLS

The most gratifying result of the trip, to my mind, is the wider knowledge which was gained of the excellence of the medical colleges of the countries visited. The medical course in all of the schools consists of six years' training. With one exception, Cartagena, the colleges are well equipped, and have excellent laboratory facilities. In Cartagena two years of the course is devoted to tropical medicine and diseases, and sanitation.

In the Medical School in Caracas there were three hundred students, sixty in the senior class. Their training in tropical medicine and sanitation is obtained in the hospitals.

Brazil has five medical colleges, an Institute of Tropical Medicine, and there is to be established a special School of Preventive Medicine. All kinds of biological products, except salvarsan, are manufactured in the Institute, including snake-bite serum. Large quantities of these products are exported. A library, printing plant, and a box factory are part of the facilities of this institution. São Paulo has a modern laboratory at the Snake Farm where biological products are manufactured. They specialize in serum for snake bites.

The Medical College of Buenos Aires occupies an entire square of ground with complete equipment and an extensive library. This college has medical, dental and pharmacal departments, and a school for midwives. At present there are 4,000 students enrolled, many of whom are women. The laboratory, owned and operated by the Republic, is the most complete in the world. It is three stories high, built of stone and concrete. All biological products are made here, and they are dispensed free of charge. This laboratory produces over a million dollars' worth of products annually. Ample funds are provided by the Congress and it receives large amounts from private sources.

The medical department of the University of Chile, at Santiago, has fine buildings, a large lecture amphitheatre, modern anatomical rooms and a good library. There are twelve regular professors and forty-five assistants. Dr. Arturo Alessandri, the President of the Republic, is greatly interested in medical progress. With the Federal Department of Health he has written a new sanitary code.

The buildings of the Medical College of Lima, Peru, cover several squares. The departments are well equipped, and there are many able men on the Faculties of Medicine and Dentistry.

The medical men in charge of the medical colleges, and those we met engaged in public health work, were, without exception, cultured, scientific-minded, and enthusiastic in the cause of progressive medicine. To find the medical schools models of perfection, higher standards for the students as high as our own, was an agreeable surprise and an incentive to further efforts in behalf of our own colleges.

This tour, conducted under the auspices of the American College of Surgeons, is one of the most significant events in our medical annals. It implies an exchange of thought and ideas with the great medical colleges of the southern countries and a better understanding of the health problems of the world. It further implies more extended relations, medical and commercial, between the countries of the two continents which will be of reciprocal advantage.

ACTIVITIES OF THE HEAD SURGEONS

By JOHN F. BARNHILL, M.D., F.A.C.S., Indianapolis, Indiana

VERY soon after the departure of the *Vandyck* from New York, it was learned that a number of head surgeons were making the cruise to South America, and an inventory of the passenger list revealed that eighteen such specialists were on board. A call for a meeting was issued, largely for the purpose, it was stated, of promoting early and friendly relations among the Fellows. It developed, however, at this first meeting that not only did those present wish an organization that would be social in nature, but also, in so far as might be consistent with the utmost enjoyment of the journey, one that should be largely of a scientific nature. Accordingly an organization was proposed which would meet both scientific and social purposes.

Dr. John F. Barnhill, of Indianapolis, was unanimously chosen Chairman and Dr. L. deV. Chipman, of St. Johns, New Brunswick, was elected Secretary. At this time no name was given to the organization, as none was then thought necessary. However, at the last session, held just before landing in New York, it was suggested, in view of the fact that the members had taken such a lively interest in all the meetings held during the journey, and of the evident benefit received therefrom, that a name should be chosen, and a permanent organization effected. This was thought especially desirable since it seemed entirely probable that other similar journeys of the College would be made in the near future. After considerable discussion of proposed titles it was finally voted to call it "The Society of Head Surgeons, Section of Travel, of the American College of Surgeons."

The following surgeons enrolled as charter members of this section:

O. Miller Babbitt, Portland, Oregon
Ivan P. Balabanoff, Tacoma, Washington
John F. Barnhill, Indianapolis, Indiana
Rodolph Boulet, Montreal, Quebec
Frederick D. Branch, Binghampton, New York
De Witt C. Bryant, Los Angeles, California
Frank E. Burch, St. Paul, Minnesota
L. DeV. Chipman, St. Johns, New Brunswick
John H. Kincaid, Knoxville, Tennessee
George A. Leahey, Lowell, Massachusetts
James M. Patton, Omaha, Nebraska
G. William Schlindwein, Erie, Pennsylvania
Carroll Smith, Spokane, Washington
Frank M. Sulzman, Troy, New York
Lewis H. Taylor, Wilkes-Barre, Pennsylvania
Frank J. Van Kirk, Bellingham, Washington
W. E. Waddell, Los Angeles, California
John A. Winter, Duluth, Minnesota.

The Chairman in assuming the duties of his office made fitting acknowledgment of the honor conferred upon him by his confrères. He referred to the fact that a Committee on Scientific Meetings had already been organized for the purpose of presenting and discussing surgical subjects throughout the entire period of the cruise. In view of this general committee he was of the opinion that it would be a splendid thing for the members of the newly formed Head Section to attend all general sessions as well as their own, and he hoped all would avail themselves of the rather unusual opportunity to do so, for, he further stated, he fully believed that attendance upon the sessions of the general surgeons, and active participation in the proceedings, would be helpful not only to the head specialists, but to all, in that it would bring surgery of the different specialties into a more harmonious and helpful relationship.

During the cruise ten sessions were held. The subjects presented and discussed on the down-going voyage covered a wide field and included nasal and sinus infection, pain from whatever cause, hæmorrhage from every source, and magnets and their use in ophthalmology.

On the return trip, very naturally and most helpfully, all discussions were carefully limited to observations that were made by the members at the various hospitals, medical schools and clinics of Latin America which were visited. One city at a time was dealt with, and comment and comparison was freely made of the men and methods in Rio de Janeiro, Buenos Aires, and Montevideo, with other men and methods which had been noted in similar clinics in cities of Europe and America.

In view of the fact that the Fellows were on a vacation, their attendance at all sessions and their sustained interest was little short of remarkable. Because of the promptness and evident enthusiasm with which all of the scientific programs were carried out, a Fellow of the cruise, evidentally in envy, dubbed the section "The Eternal Meeters." This title correctly described the conduct of the members, and they continued to merit it, so great was their loyalty to the last day of the voyage.

Through a misunderstanding, no clinics were provided at Rio de Janeiro for this section on the occasion of our first visit. The Fellows, therefore, employed their time in driving about the beautiful city, in attendance at general surgical clinics, and in visiting the medical school and the Oswaldo Cruz Institute. The chairman of the section called on Prof. Joas Marinho, a leading laryngologist and clinician, and Professor of Oto-laryngology in the Faculty of Medicine of Rio de Janeiro, in the hope that clinics might be arranged by him on the occasion of the return visit some three weeks later. Dr. Marinho, although in the midst of a busy afternoon's consultation, showed the visitor every

courtesy, and finally conducted him personally over the four separate floors of his office building used exclusively for laboratory and consultation purposes. The assurance was readily given that clinics would be arranged by him and his associates on the occasion of the return of the S.S. *Vandyck*. Accordingly, on March 28, on landing once more in Rio de Janeiro, Professor Marinho met our group and drove us to the San Francisco Hospital, where he and his associates conducted a clinic for the special benefit of the visitors.

The throat and ear department of this hospital is quite modern. Dark stalls are provided for individual treatment. Local anæsthetics are used almost exclusively in all operations, either in general or special surgery, thus giving the name, "The Local Anæsthetic Hospital" to the institution. In several cases tonsils were removed by the Sluder method, by assistants and medical students. The visiting surgeons were invited to operate, and Dr. Babbitt skilfully "Sludered" one case without an anæsthetic. Novocaine was used by injection in adults; and no anæsthetic was used for children. The tonsillectomies were cleverly done in all but one case, where a student left part of the capsule. Tonsil surgery was more up-to-date in Rio de Janeiro than in Buenos Aires, where, especially in children, the operators seemed satisfied to do the obsolete operation of tonsillotomy.

A new operation for the cure of ozena was demonstrated, the procedure consisting in opening both maxillary antra widely under the cheek, as in the Caldwell-Luc operation, curetting the mucous membrane, then incising the external nasal wall from above downward as far as possible, along the floor as far backward as possible, and then upward as far as possible, thus making a quadrangular flap with the attached base above. This flap on each side, with its attached turbinate, is then crowded over against the septum, which latter is first scarified opposite the turbinate. A heavy mattress suture is then passed from one antrum through both flaps, both turbinates and the nasal septum, being finally so tied as to hold the flaps and turbinates against the septum with which they are expected to unite. The cure is expected as the result of better nasal and sinus drainage and a greatly contracted nostril on either side.

A dexterous bronchoscopy was next performed, a new model of self-retaining laryngeal spatula being successfully used. The clinic was concluded by a splendid moving picture demonstration of the removal of a papilloma from the larynx by Dr Marinho and his assistants.

The Fellows were well pleased with these clinics and showed their appreciation by a rising vote of thanks to Dr. Marinho and his corps of able associates.

Before reaching Buenos Aires our Fellows sent a wireless message to Dr. Arce, head of the committee that was to provide clinics for the visiting Fellows, stating that the subsidiary section of head specialists would appreciate any courtesies the eye, ear, and throat specialists of his city might be able to show in the way of special clinics. Accordingly much surgical work of the head, and especially of the eye, was provided by some of the leading teachers of this great clinical center. That the work in ophthalmology is well in advance of oto-laryngology was clearly evident. Dr. Burch, who made observations on the clinics of the ophthalmologists, has noted these facts. In some of the hospitals oto-laryngology has not as yet been fully recognized, and even in the teaching hospitals provision for the teaching of these subjects has but recently been made, and is not always fully up to modern standards. It was the opinion of all of our Fellows, and the subject was freely discussed on the homeward voyage, that oto-laryngology in Buenos Aires is from five to ten years behind the times, but that ophthalmology is fully up-to-date in every respect.

Enormous clinics in all these subjects were witnessed. The clinicians were skilful, rapid and dexterous. Practically all had received graduate instruction in France, England, or America. The backward status of the specialists was, therefore, not wholly due to the clinicians, but more perhaps to the restraint due to the newness of the work in a modern form. As in almost all surgical operations witnessed in South America, ear, nose, and throat operations were performed without nurse assistants, and often without any assistant. The dexterity with which many operations were performed under such circumstances appealed to the visitors as rather remarkable. Tonsil, septal, sinus, and even brain operations were performed with either no assistants or but one assistant, the surgeon preparing the patient, attending to the sterilizing of material, and even to the threading of the needles. In Montevideo the clinics were equal and similar to those of Buenos Aires.

On the whole the Fellows of the head section felt that they had been well repaid for their visit to the South American clinics. While some criticism of methods was made, all conceded the warmest praise for the clinicians, for their kindly consideration of the Fellows in the clinics, and for their hospitality in general. Undoubtedly all will for a long time remember the joys of the journey, the spirit of the surgeons who so willingly provided clinics, and the very generous hospitality of all the people.

OBSERVATIONS IN OPHTHALMOLOGY

By FRANK E. BURCH, M.D., F.A.C.S., St. Paul, Minnesota

At the time of our cruise, there were in the countries visited only a few Fellows of the College who practised ophthalmology, and our opportunity for observing eye work was therefore limited. Our visits, in most instances, were unannounced, but we were received with a cordial welcome everywhere and we observed the routine work of the clinics.

Most of the men we met had received their training as assistants in the local hospitals and clinics, with supplementary training in France, Germany, or Italy. In Havana, Panama, and Caracas we met men who had received their post-graduate training in the Eastern cities of the United States. There was no systematic post-graduate teaching in any of the cities visited. Undergraduate teaching of ophthalmology, at least in the universities of Brazil, Argentina, and Uruguay, usually includes attendance upon lectures and clinics for a period of 3, 4, or 6 months, as a rule no special examination being required. However, in Buenos Aires, the examinations in general medicine and surgery often include questions pertaining to ocular diseases.

Hospital records were good, especially so in the eye wards of the Ancon Hospital in Panama, and at the University Clinic and Hospital Optalmologici of Buenos Aires. The last mentioned was the one institution visited in which only eye work was done. Built at a cost of $800,000, containing 120 beds, with spacious wards, consulting and examining rooms and out-patient departments, it was a surprising revelation in hospital architecture, probably unexcelled anywhere. The out-patient attendance was 600 daily, the most prosperous looking recipients of charity we had ever seen. No private work is permitted in this or in any other *public* hospital.

The Staff consists of fifteen attending surgeons under the able directorship of Dr. Adolfo Oyenard. All are alert, young, progressive surgeons doing a quality of work comparable with that to be seen anywhere.

This institution and its staff, while new and in a formative period of development, without adequate laboratory equipment as yet and no training school for nurses, but with no precedents to overcome, will undoubtedly develop into a great ophthalmologic center for special training in eye diseases. In the matter of operating rooms, careful preparation of cases, operative technique and surgical dexterity, the eye work compared equally with that observed in Continental or North American clinics. In the absence of trained nurses and training schools in the majority of South American hospitals, the surgical work observed and the evident results appeared truly remarkable to us. Like comment will apply to the hospitals themselves and to the men and the quality of work observed at the University Clinic and at the British Hospital. The latter institution has an excellent nursing staff and training school.

At the University Clinic, in the absence of Prof. Enrique Demaria, Chief of Clinic, in Europe, Dr. Atilio Tiscornia and Dr. Paul Aganaras, held an impromptu clinic in our honor. Prof. Pedro La Gleze worked and taught in this hospital for a quarter of a century. His remarkable personality and leadership in ophthalmology has been an outstanding factor in the development of ophthalmology in the Argentine, and in the training of the present generation of ophthalmologists. All of the men refer with highest respect to his great originality, clinical observations, and pathological research, as well as to his qualities as a great teacher.

Everywhere one noted excellent work under local anæsthesia. In practically every clinic visited, we found enucleations done under novocaine. Paraffin is preferred to other substances for implantation. Our visit to the pathological laboratory proved most interesting. Fine work was evident, specimens were well cataloged, and there was an excellent museum. Among other unusual specimens was one of intraocular hydatid cyst, completely filling the vitreous.

There is an excellent Academy of Ophthalmology of Buenos Aires which has collected and published its papers at various periods. A review of its bulletins and year books shows every evidence of progressive, scientific, and much original production in advanced ophthalmology, not fully appreciated by those not conversant with Spanish medical literature.

Much of the clinical work in Argentina and Uruguay has to do with trachoma and its sequelæ. Trachoma is not well controlled and apparently is spreading in many regions. We were told that in some of the Argentine states, approximately 70 to 80 per cent of the inhabitants are afflicted with trachoma, the provisions for inspection and exclusion of immigrants being more or less perfunctory. Unfortunately, Mediterranean emigration is bringing a serious problem to South American shores in the unchecked tide of trachoma.

Cataract surgery is very decidedly "orthodox" in type, although there are fewer iridectomies, and less use of capsule forceps and anterior chamber irrigation, than with us. There is no manifest enthusiasm over adoption of intracapsular methods of extraction, even of the Spanish method. The use of the conjunctival bridge in extraction is popular with many of the surgeons. One sees relatively more simple extractions here than in Europe or North America.

Elliot's trephine operation for glaucoma simplex and broad iridectomy for acute cases is the common procedure. On inquiry, cyclodialysis, sclerectomies and sclerotomies do not seem to be the vogue.

Muscle surgery is perhaps not as highly developed as one would expect considering the fact that nearly everywhere one found good records of muscle balance tests. One of the leading surgeons states that few cases are operated upon before the age of puberty, and that practically nothing is being done to train fusion. Practically all muscle cases are treated as out patients. The La Gleze tuck is still the favorite method in Buenos Aires. Tucking instruments do not seem to be much used. Tenotomies are perhaps still too popular.

In Montevideo, the principal eye clinic is that of Prof. Alberica Isola at the hospital Maciel, a large general hospital almost a century old. With kindly courtesy Dr. Isola showed us his clinic in operation, demonstrated most of the modern diagnostic instruments, including the red-free lamp, Cullstand ophthalmoscope and slit-lamp microscope. He also showed us a very interesting pathological collection. He is a strong advocate of foreign proteid therapy and tuberculin. Dr. Martin Martinez-Pueta, his assistant, is thoroughly up to date. In this clinic, as everywhere in South America, refraction work, at least in the public clinics, is largely carried out without cycloplegia, excepting with children, much as is done in Vienna.

In Rio de Janeiro, the University was closed at the time of our visit and Dr. Abreu Fialho, the chief of the department, was at his summer home in Petropolis. At the Santa Casa hospital, his assistants showed us many interesting and unusual cases, including the convalescents. The operative results were excellent. The equipment and laboratories were modern and all the evidence pointed to good diagnostic work. There were separate operating rooms for clean and infected cases. Considering the lack of nurses, one wonders how such excellent results are attainable. Apparently every surgeon learns to become self-dependent and there is a minimum of "handling." Perhaps we may learn something of value from these observations.

At the Policlinic in Rio de Janeiro we visited the veteran, Dr. Brasil, whose outpatient service is very large, with the usual South American percentage of trachoma cases. His results with simple extraction for cataract were very excellent.

In conclusion, one may infer that, with a proper command of the language and more time at one's disposal, much of interest might be seen, even considerable that is new, especially in therapeutics. We were firmly convinced that the near future will bring rapid developments in ophthalmology in South America. Surely, the sixteen ophthalmologists of the cruise party will return to their native shore with many pleasant memories of the courtesies extended to them, and a most favorable impression of the special work observed in this field of surgery.

LATIN AMERICAN HOSPITALS

By EDWARD I. SALISBURY, M.D., Denver, Colorado

ONE of the dominant features of the recent mission of friendship of the American College of Surgeons to our neighbors to the South was the study and observation of their institutions; and to the surgeon, the most interesting among these is the hospital.

In comparison with our own great hospitals we can offer a criticism or two, constructive perhaps; but on the whole we found in our casual survey much to admire, much to praise, and many things worthy of imitation.

The Latin American hospitals are sustained in much the same way as ours of the North. The government probably comes first in the support of hospitals. By government I mean either the central power or the state. The municipality as a rule does not maintain hospitals. This is due to the system of revenues and tax impost, which levies are collected by the central government. And indeed in many instances one or two port cities support the whole country. Appropriation is then made by Congress to finance the public institutions of the several cities. This system has given rise to a lack of civic spirit, as in every improvement and in every public innovation the cities look for governmental aid. Therefore, the greater number of hospitals are state or federal institutions.

The *beneficencias* are next in importance in the support of the hospitals. They are beneficent associations which derive their funds from contributions and endowments by public-spirited citizens, from legacies, from the revenues collected by theatres, lotteries and the like, all of which are often supplemented by the government in the form of allotments to cover any deficit in the budget or an allowance of a certain percentage of duty collections on a given commodity or luxury.

Foreign colonies maintain many institutions such as the French, Spanish, Italian, German, British, and North American Hospitals. These hospitals receive support from their respective colonists and are conducted as pay institutions. A discount is allowed to the members of the hospital association, and free treatment is given to the poor of the respective colony.

Another type of hospital is the private sanatorium or *Casa de Salud* (House of Health), usually conducted by individual doctors or groups of specialists who form a partnership.

The first three types of hospitals, as a rule though not in every instance, maintain paid staffs, from the Chief of Staff to the visiting and resident physicians and surgeons. These posts are sought often from the monetary standpoint, while the work is "farmed out" to younger men looking for experience under capable instructors. Of course, a paid staff is a great drain on hospital funds that would be available for other uses and extensions if the system common to us prevailed.

The pay departments of the public hospitals and of the private hospitals are usually open to any reputable physician or surgeon who wishes to take patients into the institution.

The administration of the hospital is left to a board, or *junta*, of individuals, usually including members of the medical profession who are locally interested in public welfare. This board appoints a superintendent and assistants, matrons, nurses, attendants, etc. Often Sisters of Charity or of the other religious orders supervise the hospitals; but nowhere are hospitals conducted in buildings that are the property of the sisterhoods as is the rule in the United States and Canada. This custom may not have prevailed originally, but the property of religious orders has since been taken over by the state, and the sisterhoods are allowed maintenance and pay for the services of their individual members who do charitable work.

Training schools for nurses, with two or three year courses, exist in many of the hospitals. In some cities only one hospital has an accredited school which supplies nurses to the other institutions.

The hospital buildings are commonly one-story structures with high ceilings, well lighted and ventilated. Each ward is a distinct building and is separated from the other units by garden courts which add beauty and charm, and give surroundings that materially aid the patients in convalescence. The wards are connected by verandas which make for service and efficiency. Occasionally the hospitals are built on the isolated pavilion, or Virchow, plan with subterranean connections, as with the Pareyra Roselle Hospital of Montevideo and the Calixto Garcia Hospital of Havana. In the latter, however, the original plan to connect the buildings has not been carried out, and there is difficulty in the movement of patients, food, linen, etc.

In almost every instance the equipment in the hospitals, especially in the operating sections and laboratories, is modern and adequate in every way. A custom common to most of the Latin American institutions, perhaps because of the absence of nurses, is the peculiar system in regard to drugs. By far the largest department of the hospital is the drug store. A large force is maintained in each, and all pharmaceuticals are manufactured on the grounds; drug mills, mixers and elaborate machinery are ever present in the *Botica*. From 300 to 1200 prescriptions are filled daily and the several remedies for the patient are placed at his bedside in lieu of a set of standard formulæ at the nurses' desk.

The kitchens of all the hospitals are examples of neatness and cleanliness, and apparently good, wholesome food is served. The beautiful white-tiled

kitchen in the Central Hospital of São Paulo, with its battery of large steam cookers and open hearth grills, is typical of any modern culinary department found in the North.

I regret to state that screening has been neglected in most of the institutions I visited, and goodly numbers of flies were in evidence.

Most of the wards were overcrowded, and it appeared that this was not due so much to the number of acute cases as to a certain oversight in discharging patients who are able to leave the hospital. In late convalescence they hold many patients longer than we would do ordinarily.

Interesting, indeed, is the history of the hospitals of our Southern neighbors and the transition that has slowly taken place during the centuries. Every hamlet had and has today its hospital, something that cannot be said of our own country. A century before the Pilgrim Fathers landed at Plymouth, Panama had its hospital; but that was destroyed by Morgan when he burned the city. Two decades later, just 380 years ago, Bras Cubas "Fidalgo do Puerto Portugues" established "La Santa Casa da Misericordia" in Santos, Brazil.

From their resting place in the safe the *Administrador* of this hospital brought forth and showed to me the original *compromisos*, or articles, written in old Portuguese, establishing this ancient hospital. Parts of the old buildings are in use today. The history of this hospital is the common story of all. Many began in monasteries and a section was set apart as a hospice (hence the name hospital). Daily the poor or travellers came for food. If they were sick they were taken in. As the monks were skilled in the treatment of wounds, they were sought by the *conquistador*, the soldier and the mariner. Later the sisterhoods came, and the Sisters being by nature better adapted to the care of sick and indigent, the institutions became almshouses and sheltering homes. As time went on these places "specialized." Some became orphanages and some asylums for the aged or for the insane; something of a hospital was left for the sick. None but the poor entered, as the better classes were treated in their homes. Then came the wars for independence. The wounded soldier was brought into these institutions which often served as barracks as well. The early days of the republics found many poor. During the troublous times the gentry left the farms of plenty and took refuge and protection in the city. The men died in battle and the countryside was deserted. The capacity of the hospital was strained and the few Sisters could not care for the innumerable patients. The poor came in to help and they were the first class of lay nurses—menial laborers, nothing more. They were poor and untrained, and as the successors of these people came they were poor also and so uneducated. Thus nursing has not risen to a profession of highly trained and educated women as we know it to be.

The period of transition is at hand, for, mark you, the science of medicine and surgery has advanced and hospitals cannot be conducted without trained help. Not only is this true, but the home is no longer considered a desirable place for the sick. Our Latin American friends realize this and three important advances have been made: first, hospitalization being necessary, the better classes must be provided for, and as a consequence we find private hospitals springing up. The nurses are trained by the doctors in charge in much the same way that a stenographer in a doctor's office is trained to be an office nurse: second, to provide better trained help for the public hospitals, training schools have been started, and to be sure the first students are from the humble classes with only meager primary schooling; lastly, and most important to my mind, the middle classes, who cannot afford the private hospital and who do not wish to be considered paupers and be admitted to a public ward, must be provided for, so *Pensionadas*, or pay departments, have been established in the public hospitals. They are termed, according to their ability to pay, as first, second, and third class, and are given private, semi-private, or small ward services.

This, I think, shows a trend in the right direction. The public will soon be fully cognizant of the advantages and protection of the hospital and demand good nursing. This in turn will raise nursing to the dignity of a profession with a consequent demand for educated women of the better families, and it will encourage women in general to enter the professions and participate in public affairs. Even today the upper classes are taking an interest in nursing. Since the World War the work of the Red Cross nurse has created in the minds of the people a new and favorable impression of the trained nurse. Local chapters of the Red Cross have been established in the various Latin American countries, and now we find the wives and daughters of prominent families studying nursing in the day schools of the Red Cross, that they may go out and assist in public health and welfare work.

Many of these women have taken an active interest in Child Welfare and assist daily in the nurseries or milk stations where infant feeding and hygiene are taught to poor mothers. In Santiago, Chile, there are eleven of these stations, called *Gotas de Leche* (Drops of Milk), and they are doing a very laudable work.

All, I think, in time will lead to the desired result, viz.: A standardization of all hospitals such as we have today in the United States and Canada.

Space will not permit me even to enumerate the many hospitals that we visited in fourteen prominent and many lesser cities in Latin America. Everywhere that we attended clinics we saw the highest type of work and learned many things of interest. We saw many of the best surgeons operate in well-appointed clinics under ideal surgical asepsis, and with classical technique. We have returned, enriched in wisdom in many ways; and we have discovered clinics that we can visit with profit again and again.

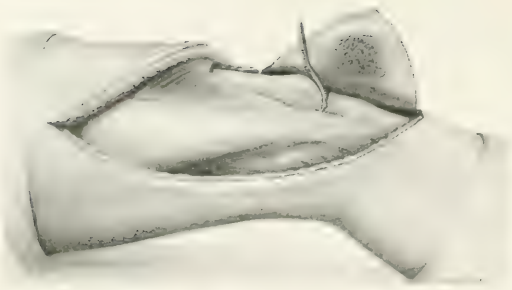

Fig. 31.

Fig. 34.

Fig. 32.

Fig. 35.

Fig. 33.

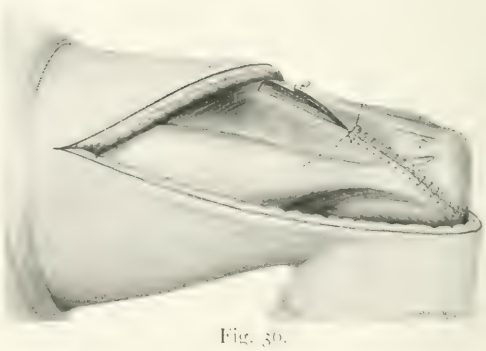

Fig. 36.

Fig. 31. Displacement of the patella with inner capsule inward and division of ankylosis.

Figs. 32 and 33. Luxation of the joint and remodeling of the femoral and tibial surfaces. Note the exaggeration of the spine of the tibia.

Fig. 34. Attachment of the fascial flap to the posterior capsule.

Fig. 35. Completion of the suture about femoral end.

Fig. 36. Suture of the capsule and elongated quadriceps.

Mobilization of Ankylosed Joints.—W. Russell MacAusland

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MOBILIZATION OF ANKYLOSED JOINTS[1]

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INTRODUCTION

MUCH progress has been made in the surgery of bones and joints in recent years, due largely to the extraordinary perfection of technical methods and the persistent efforts of a few able leaders. Probably no section of this field has occupied so much interest and effort as the surgery of stiff joints.

The best teaching, until very recent years, dealt almost entirely with the proper position in which a joint should be allowed to ankylose so as to permit the best function. The shoulder *stiff in abduction* is certainly much better functionally than the shoulder stiff at the side of the body; the knee *stiff in almost full extension* is undoubtedly far less of a disability than the knee fixed in marked flexion. And yet, with the gradual development of surgical technique, certain pioneers in joint surgery have tried to increase function by different methods.

Although the mobilization of ankylosed joints was at first, and is even now, attempted by only a few surgeons, several good results arising in a sea of failures led the pioneers onward to develop this new field of surgery. Foremost among them is the late John B. Murphy, of Chicago, to whom we pay a tribute of admiration for his constructive efforts founded on a vast accumulation of clinical and scientific material. The results of operations have been sufficiently definite so that various methods may be presented with the assurance that they will continue to be more or less standard in future work. Today Payr, Putti, and Baer, persisting in the face of adversity, have opened this limited field of surgery so that carefully trained operators with highly developed technical skill can now present results which show only a small percentage of failures. The risk to life is very low and the margin of good results reasonably certain.

ARTHROPLASTY NOT AN EXCISION

Arthroplasty, or the operation of mobilizing ankylosed joints, is not an excision. Murphy has well said: "Arthroplasty to be functional must be stable, and excision of joints results always in flail joints." A flail joint cannot be considered a proper result from a plastic operation. Excision has no place in the surgery of weight-bearing joints, save to obtain ankylosis, nor would it be used in non-weight-bearing joints if it were not that flail joints may be stabilized by means of light apparatus.

Those who attempt to mobilize ankylosed joints must approach the work well trained, must show great technical skill, and, above all, must exercise judgment in their selection of cases, if they would qualify for this work.

I present the subject of arthroplasty to you, therefore, in order to stress these important points:

[1] Presented before the International Congress of Surgery, London, July 18, 1923.

1. That excision of a joint does not constitute an arthroplasty;
2. That highly developed technical skill is absolutely necessary;
3. That the judgment in the selection of cases is very difficult.

Types of Ankylosis—Infectious, Non-Tuberculous, Traumatic

Ankylosis is the result of an infectious process or traumatism. The latter is usually a fracture dislocation with wide separation of fragments, followed by excessive callus. The ankylosis in these traumatic cases is usually a firm fibrous formation, although occasionally a true bony ankylosis may result.

The infectious process may be either acute or chronic. In the former case the causative agent is usually the streptococcus, the pneumococcus, or the gonococcus. In these infections the onset is sudden, and the course severe, ending usually in a bony ankylosis. We may, on the other hand, have a slow, insidious, polyarthritic process. The focus of infection is situated elsewhere and the joint condition is caused by the hæmotogenous deposits in the joint, either of attenuated bacteria or of toxins. The primary focus is often difficult to locate. The ankylosis results from adhesions both within and without the joint, and is, at least at first, fibrous in character.

Murphy (120, b) believed every type of non-traumatic joint inflammation to be the metastatic manifestation of primary infection in some other part of the body. Sometimes long periods elapse between the primary infection and the secondary arthritides. Gonococci metastases usually occur in 18 to 20 days, staphylococci in 10 to 14 days, and streptococci and colon bacilli in 8 to 10 days. These metastatic joint infections are initiated with a chill, and are not rheumatic in character.

The synovia is first involved; the serous surface of the membrane is destroyed in large and small areas. Up to a certain extent it may be repaired. In extreme erosions subserous tissues bridge over the spaces between the serous erosions, and adhesions result. The gonococcus, pneumococcus, and streptococcus may produce this condition. Pathology shows thick, porky infiltrations of the synovial membrane, œdema of the subserous surfaces, and injection of the surface toward the joint. The cartilage is not affected at an early date. In repair, the proliferated epitheloid cells become obliterated.

Causes and Extent of Ankylosis in Relation to Mobilization

It is important to emphasize the necessity of determining the cause of ankylosis, for it makes a great difference whether the ankylosed joint is the result of fracture or of disease, or whether it is congenital.

Infections, either acute or chronic, do not constitute a contra-indication to the operation, provided that the process has not been tuberculous or is not active. It is well to point out that many joints, apparently firmly ankylosed even by a bony bridge, may retain active infectious agents for a year or even two years. A tuberculous joint, even when ankylosed firmly, may retain small walled-off foci throughout life, and, therefore, except in cases of great rarity, should be considered a direct contra-indication to any mobilizing.

Certain infections cause great destruction of bone and injury to the soft structures of the joint. Where such destruction is extensive, or where there is marked scarring of the tissues, a difficult operation may be expected.

Occasionally deformity of such extent is present as to warrant the correction of the deformity before arthroplasty is attempted. The hip, for instance, ankylosed in marked flexion and adduction, will present a very difficult operative problem, unless the deformity is first corrected by a preliminary procedure. Marked flexion of the knee, although not so important, may also necessitate a preliminary intervention.

In general, I have found bony ankylosis easier to deal with than partial or the so-called fibrous type.

Indications and Contra-Indications for Arthroplasty

Any ankylosed joint might be considered for arthroplastic procedure, but there are definite limitations, and therefore we come to have certain fundamental indications for arthroplasty.

Major joints. First, two stiff hips will indicate arthroplasty on one hip, or possibly both. Second, two stiff elbows will present the same indication. Third, two stiff knees will present a definite indication for an arthroplasty on one side, at least. Fourth, combinations of hips and knees in the same individual, a condition not infrequently seen in multiple arthritis, is a very definite indication for attempting to mobilize one or more joints. The surgeon considers in all of the above indications the anatomical and occupational status of the patient.

Minor joints. Among the lesser joints which may be considered properly a subject for intervention are: first, stiff shoulders; second, stiff fingers; third, stiff wrist (a very rare subject for arthroplasty); fourth, the jaw, which demands arthroplasty.

In general it may be said that definite indications naturally rest with the judgment of the surgeon, but must depend to a large degree upon the patient. One stiff elbow, for instance, in some individuals is a very slight disability; in others, it is of supreme importance. It is necessary, therefore, that each case be considered upon its merits and not upon the mere desire of a patient to be able to move a joint. There should be considered constantly the question of whether the deformity may be actually the principal source of disability, and whether, as has been mentioned before, correction of deformity may not give sufficient relief to the patient.

Methods of Treatment—General Survey Prior to Arthroplasty

Many means have been used to gain mobility in ankylosed joints. Previous to 1860, *brisement forcé* was the general method of treatment. It is still in use, and in properly selected cases the results are good.

J. Rhea Barton (11), of Philadelphia, in 1826, first attempted pseudoarthrosis in the case of ankylosis of the hip joint. The operation consisted of an osteotomy through the femur above the trochanter and the attempt to prevent bony union by movement. The patient lived 6 years with a good weight-bearing leg and some motion in all directions.

Rodgers (155), of New York, modified this method in 1830 by removing a disc of bone from between the trochanters. He obtained a more satisfactory result. Bérard (13), Esmarch and Rizzoli, both reported by Murphy (120, g), and McIlhenney (114) used similar methods for treatment of the jaw.

In 1880, Wolff (197) recommended a method which he called arthrolysis, which consisted of chiseling through and dividing all fibrous or bony adhesions, without resection of the articular extremities that had been restored to their normal position. Wolff claims favorable results in nine cases, four of ankylosis of the fibrous type and five of the bony type. It is probable that he did not treat a true bony ankylosis.

Kocher (103) suggested dislocating the joint for a short period after arthrolysis. No success is reported.

Actual resection has a few advocates. Good functional results have been reported in a proportion of cases of ankylosis of the jaw, elbow, and hip. Koenig (104) recommended resection in wide luxation. Textor (178) in 1843 reported a case of ankylosis of the elbow in which there was full range of motion 6 years later. Ferguson (63) secured a weight-bearing limb by resection of the knee. Dautrelepont (45), Czerny (42), and others observed that a new joint cavity with synovial membrane and articular cartilage formed 3 years after resection. Sayre (161) and Defontaine (47) tried to fit bony ends after the fashion of an articulation. They obtained stability, but adhesions formed again. Dartignes (44) described a trochleariform osteotomy; he resected the joint surfaces with preservation of their form. The result was ankylosis again. Cavazzani (29) liked to spare the bone and soft parts for the preservation of the physiological function. He emphasized a transverse incision.

Painter (133) recommended excision, for in arthroplasty he feared the extrusion of the interposed material, or infection. Resection cannot, however, increase function in a weight-bearing joint, as the one essential—stability—is lacking, and, while resection in the upper extremity is practised and is as good as a poor arthroplasty, it does not measure up with a

good arthroplasty either in surgical technique or in functional result.

Very little has yet been done in the transplantation of half or whole joints. Lexer's (110) first case was to implant in a stiff elbow of gonorrhœal origin the patellar surface of the femur. The result was fibrous ankylosis. His next step was to use a transplant of the entire knee joint. The knee joint was fixed in acute flexion in bony ankylosis, resulting from articular suppuration after purulent osteomyelitis of the femur. He made an anterior flap incision, the soft parts remaining in contact with the flap. All lateral and posterior coverings were detached. A new joint, obtained from a limb amputated simultaneously for senile gangrene (without phlegmon), was fitted in. In this case he neglected to place tissue beneath the patella, thus necessitating a second interference. Fixation by plaster cast from toes beyond the iliac crest followed. Three months later the epiphyses were in firm union, the semilunar cartilage preserved, and the articular cartilage was smooth. A small spicule of bone was later excised and analyzed. The transplanted portion had become a part of the new organism.

The second case Lexer reported was a transplantation for bony ankylosis of a tuberculous knee joint. The entire joint was again taken from a freshly amputated limb. In both cases the extremity was somewhat shorter. The knee joint was in normal extension. Lateral motion was present in the second case. Both patients could bear their weight well when walking or standing. Lexer then aimed to obtain function by muscle plastic elongation of the efficient non-atrophic muscles.

Herzberg (83) reported four cases in which transplantation of joints was done after resection. Three of the cases were children.

Eloesser (60) reported a case of implanting a cadaveric joint consisting of three inches of tibia, fibula, and astragalus. The attendant dropped the implant during the operation, which necessitated heating it. Suppuration developed and the foot was amputated. Examination showed the tibia was invaded by new bone in all stages of formation. In a case of implanting a finger joint from the cadaver, 35 degrees active motion and 60 degrees passive were secured. Movement was improving at the time of the report.

Goebell (72) implanted a toe joint into a finger resected for severe arthritis deformans. A good movable finger resulted, and the patient, a violinist, resumed her profession.

G. T. Vaughan (185), of Washington, was unsuccessful in replacing a knee taken from the cadaver. The graft became the site of suppuration.

Kuettner (106) reported two cases of implantation of femoral neck and head, using the cadaver as the source of material. One patient walked without a cane and had considerable motion. An autopsy at death from vertebral metastasis, 1 year and 1 month after operation, showed the joint fixed to the femoral shaft by a narrow ring of bony callus. The whole graft was covered by a membrane similar to periosteum. The second case remained cured 3 years and 2 months. Local recurrence necessitated disarticulation of the hip.

Deutschlander (52) tried transplanting in a child of thirteen a graft containing the joint extremities of the femur and tibia with the greatest part of the joint capsule, menisci, and ligamentous apparatus. Ten months after the operation, the transplant was luxated and removed.

Oehlecker (126), in 1922, reported the outcome, after 6 years, of eight cases in which an entire joint was transplanted into a finger. In four cases the joint was taken from the patient himself and in others from another person. The results in the autoplastic cases were more successful.

Work with whole and half joints has been done by Sievers (169), Petraschewskaja (137), Katzenstein (97), and Buchmann (24).

There is much discussion in regard to the regeneration process. Axhausen (8) in 1907 proved that periosteum and endosteum of implants remained alive. Eloesser (60) believes regeneration takes place in part from the elements of the graft itself.

The cadaver material is easier to obtain than a living graft, but infection must be avoided. The joint is removed within 12 hours after death. The Wassermann test is used on the blood and part of the bone marrow

is incubated in broth. The joint is implanted in Ringer's solution for 24 hours. It is then freed of all adherent tissue and muscle.

In the operation a horseshoe flap is outlined and the bone is sawed close to the joint. The new joint is inserted by mortising and held in place by catgut. Traction is secured by adhesive plaster strips. A plaster-of-Paris splint is then applied. General passive motion is instituted in a week.

This surgical procedure seems at once radical and dangerous, and has not been generally accepted. Simple arthroplasty, without the use of bone transplants and with little use of any foreign heterogeneous material, has supplanted all such extravagant measures. Their interest is chiefly historical.

Various non-absorbable materials have been tried as the interposed material. Carnochan (27), of New York, in 1840, inserted a piece of wood in an ankylosed jaw. Orlow (130) in 1901 used gilded aluminum plates in two jaw cases. Roser (158), Pupovac (144), Huebscher (93), Hoffa (86), and others used magnesium plates and silver. Chlumsky (33) tried zinc and rubber, but reported no permanent results. Later he used absorbable plates of decalcified bone, ivory, and magnesium, but the results, on the whole, were not satisfactory. Gluck (70) and others inserted ivory pegs. Besides these materials, celluloid, gutta percha, and temporary packings of gauze have been used. Foederl (65) in 1903 used animal membrane or walls of ovarian cysts, but found that they caused suppuration, and re-ankylosis occurred.

Rechet (148) covered the ends of the resected bones in various joints with periosteal flaps.

Hofmann (87, a), in 1906, reported a case in which he transplanted periosteal flaps from the tibia to the resected ends of the bones of the elbow. He obtained full extension and flexion to 80 degrees.

Von Frisch (66) used periosteal grafts from the tibia in an elbow ankylosed from gonorrhœal arthritis. Only 25 degrees motion was obtained. The author attributed the result to lack of after-treatment.

Greiffenhagen (75) reported three cases in which periosteum was used in elbow joints.

A graft of joint cartilage was first used with success by Tuffier (183) in 1901 for a comminuted fracture of the upper end of the humerus. Judet (96) doubled the cartilage with a layer of bone.

Mauclaire (112) used cartilage from the astragalus to cover the rough ends. Later the X-ray showed these fused to the bone.

Weglowski (189), in 1907, reported a case in which he successfully used cartilage from the rib in an ankylosed elbow.

More recently cartilage grafts were used by Delagenière (48) after a resection had been done. The operation showed no advantage over excision, as some instability of the joint followed.

Gluck (70), in 1902, used skin flaps.

Diel (53) reported the use of reindeer tendon and the epiploon of a rabbit in a case of femoral-patellar ankylosis. In 10 months the patient could walk easily without a cane.

ARTHROPLASTY

History

Foreign substances are no longer used, and since 1900, fat, muscle, fascia, or specially prepared membranes have been inserted in the joints.

The first case of muscle interposition was in the jaw, where immobility often interferes with life. In 1860, Verneuil (186) interposed a piece of temporal muscle and fascia between the condyle and glenoid after resection. Helferich (80) and Ollier (129) developed the technique of muscle implantation and gave it general notice. In 1893, Helferich exhibited a child who had regained motion in an ankylosed jaw by use of a flap of temporal muscle. Lentz (108), Henle (82), and others repeated the operation, using muscle flaps. Both coronoid process and condyle of the inferior maxillary were removed by Bilczynski (17) and Hoffa (86), and a flap of temporal muscle inserted.

In 1895, Mikulicz (118) used a flap from the masseter muscle instead of from the temporal. Kusnetsoff (107) repeated the operation per-

formed by Hoffa and Bilczynski, using a masseter flap as the interposed substance. Rochet (154) and Schmidt (165), after the removal of the entire ramus, interposed a masseter flap.

Operations on other joints followed those of the jaw. In the treatment of the elbow, Quénu (146), Albarran (2), Nélaton (123), Delbet (50a), Murphy (120), Hoffa (86), and Schanz (162) used flaps from a muscle contiguous to the joint. Berger (15) in 1903 mobilized a fibrous ankylosis by inserting a flap of the anconeus which he sutured to the brachialis anticus. Huguier (94b) introduced in the radio-ulnar joint a layer of the posterior ulna.

Muscle flaps were then used by Rochet (154), Nélaton (123), and Hoffa (86) in ankylosis of the hip, and others used them in the knee.

Experimental Methods

Unfortunately the experimental work in arthroplasties on animals has been relatively small.

Experiments with living tissue have shown that it degenerates or is replaced by a fibrous tissue. Small cavities are formed during this process. Allison and Brooks (4) found that the end-results of simple resection of joint surfaces without interposition of a substance do not differ materially from cases in which the substance was inserted.

Murphy (120, g) destroyed joint surfaces and interposed flaps of fat and fascia. He claimed that the fat undergoes connective-tissue changes which facilitate the bursa formation.

Neff (122) reports only one successful case of four arthroplasties on dogs, using free transplants from the rectus aponeurosis. Three cases were ruined by wound infection. The successful operation on the knee showed new capsule had formed connective tissue between the tibia and femur, and that two bursal sacs had developed.

Davis (46) in his experiments on a dog found, at autopsy, that free fascia in the knee joint was adherent to the end of the femur and the material was viable. Putti (145, d) also used free fascia, and found the substance retained normal characteristics.

Kolazek (105) in five experiments on dogs excised a portion of the capsule and inserted homo-transplants of peritoneum. They healed and formed no adhesions.

Sumita (175) destroyed the joint surfaces of the knee, hip, and ankle of twenty dogs and interposed pedicled flaps of muscle, fascia, and tendon. The dogs were observed for periods of 21 to 244 days. Fibrous tissue and small cavities had formed, but the largest cavity measured only 1.5 centimeters in diameter.

Bolognesi (20), in a long series of experiments, followed the process of formation of periarticular nearthrosis. He believed that an enarthrosis or a true diarthrosis can be formed only when a foreign element is interposed, and that the means of covering the cavity had origin in the cartilage of the neoformation which covered the free fragments of the fracture.

Segale (167), in 1913, in experiments found that the joint capsule in a rabbit or dog reproduces itself from the surrounding tissues and forms a new capsule which limits the joint cavity and contains synovia. The reproduction of the joint surroundings is closely connected with the operative technique which provides for the preservation of those parts which assure a correct joint mechanism.

Ely (61) experimented on nineteen dogs, using no interposing material. Bony ankylosis developed in one case in 432 days.

Hohmeier and Magnus (90), in a series of experiments on dogs, found the end-results were the same with or without interposing substances.

Beye and Steindler (174) experimented on dogs and found no adhesions formed after mere scraping of the cartilage covering and inserting of fascia. Pedunculated muscle fascia was transformed into a connective-tissue pannus adherent to denuded areas of bone. There was complete transformation into connective tissue and no traces of original muscle fibers existed.

Experiments were then made using non-absorbable materials, but they were discarded.

Allison and Brooks (4) found that the chromicized pig's bladder suggested by Baer caused reaction in the surrounding tissues,

and adhesions formed. They experimented with silver impregnated fascia and found relatively little reaction in the surrounding tissues.

Phemister and Miller (139) obtained similar results in the elbows and knees of dogs, with or without the interposition of free or pedunculated flaps. The flaps largely broke down, and the resulting joints were alike in the three types of operation. They did not see how any appreciable amount of nutrition can be furnished by the circulation through the pedicle. They believed that the circulation in the surviving portions is through adhesions to the parts with which they come in contact.

Present Clinical Methods

The methods in use today, as outlined by Murphy (120), Payr (134), Baer (9), Allison and Brooks (4), Putti (145), and the writer (111), have in common the exposing of the joint surfaces, modeling of the bone-ends after the conformation of the normal joint, and the interposition of a substance to obstruct effectively bony union. They differ particularly in the substance interposed.

The two essential features of the Murphy treatment are the interposition of the pedicled fat and fascia flap and the application of traction. Murphy (120) emphasized the inclusion of the fat, as he believed it essential to a new joint foundation. It was his belief, too, that the flap was nourished through the pedicle. His technique in the different joints varied, not in principle, but as necessitated by the different joints. It will accordingly be treated later under each joint. The writer believes that pedunculated flaps are entirely unnecessary, and when covered with fat they interfere with the highest technique.

Baer (9) objects to the interposition of muscle or fascia for several reasons. He maintains that the structure of the joint is interfered with when a bulky substance is inserted; that too large an excision is required; that, if too little muscle or fat is interposed, ankylosis results; that the pain is severe, due to the pressure on the nerve-endings; that the motion obtained is generally unnatural in character; and that periarticular tissues are interfered with.

Baer advised chromicized pig's bladder as the transplanted medium. It is thin and flexible and conforms accurately to the surfaces of the modeled bones, and is tenacious enough to withstand disintegration for a period of from 60 to 100 days.

The use of Baer's membrane has not become universal on account of numerous failures and sloughing out of membrane, often weeks and months after the healing of wounds. Allison and Brooks (4) found that with Baer's membrane the reaction of the surrounding tissues was of such intensity that adhesions formed. In 1913 they recommended the use of silver impregnated fascia from which there was relatively little reaction.

In the use of the "free flap" as the interposing material, there is an opportunity to obtain the correct size, to determine the presence of a bursa, and to secure a good layer of fatty tissue. Putti (145) states that fascia will live after transplantation; there is, therefore, no need to use pedunculated flaps. He believes that the free fascia grows and is transformed into a tissue like the synovia. He covers the epiphysis completely with free aponeurotic flaps from fascia lata. One difficulty he has met in the use of these flaps is necrosis of the edges, a condition existing even in satisfactory cases.

Putti has been particularly successful in his operations on the knee. I shall treat his technique under the division on the knee joint.

Payr (134, b) advises the careful extfrpation of the capsular tube leading to the nerve-endings; the removal of the masses of connective tissue is not enough. Under the influence of the rapidly resumed function, there develop in and between the interposed soft portion (fat or fascia, etc.) at first multiple, and later connected interstitial spaces which finally form a joint space. A new satisfactory capsular tube is formed out of the periarticular connective tissue in which other accessory ligaments may develop by simple mechanical exercises. The new joint contains a synovial-like fluid.

Payr has obtained the best results with pedunculated flaps and freely transplanted fat. In all cases Payr has found that the opera-

tion has increased the breadth of excursion of the joint motion. Patients with an ankylosed knee, leaving the hospital with 65 degrees active mobility, showed 90 degrees or more after a year or so. The movement is usually smooth and painless. The X-ray showed the newly formed joint to be smooth and sharply defined; there are no free bodies. From a functional point of view also the new joints are satisfactory. He advises being careful in operating for ankylosis of tuberculous origin.

Payr's technique is recommended by Wollenberg (196), who, however, warns against the general use of arthroplasty, as too often mobility is purchased at the cost of an unstable joint.

The writer (111, a) first used free fascia in an ankylosed elbow in 1908. In 1914 four cases of free fascia transplants with excellent stable joints resulting were reported before the Orthopedic Section of the American Medical Association in Detroit. A series of thirty-one cases of elbow arthroplasties was reported in 1921.

Ritter (reported by Thom, 179), Behn, reported by Harris (79), Kirschner (100), and others have also used free flaps.

ELBOW

Most joints, when stiff, can be placed in a position to function well. The position in which maximum function is obtained in the elbow is near 90°, and many surgeons advocate it in preference to a mobilized joint. But ankylosis of the elbow joint, even at this most satisfactory angle, has very objectionable features.

While function may be present if the elbow joint is ankylosed in flexion, it is never good function, and the arm is always in the way. Usually, too, ankylosis is found in extension of about 160 degrees, in which position the arm is awkward, although not unsightly. Given, then, an ankylosis of the elbow joint from any cause except tuberculosis, some type of mobilization operation may be considered indicated.

Resection, which is performed for the tuberculous joint in adult patients, is the operation which is usually thought of first. The results from this procedure are very unsatisfactory, as the joint becomes flail, weak, and usually requires external support in the form of a leather armlet with limited elbow-joint motion. Excision, therefore, is rather a crude surgical procedure, and the ultimate results from its use do not warrant its being considered for any condition except tuberculosis of the elbow.

For many years the writer has been working to improve the method of procedure in these cases, and has found that, with each improvement in the technique, a definite improvement in the function of the elbow-joint motion is obtained, until finally the operation which is at present employed, namely, a true arthroplasty, has been evolved.

A good arthroplasty gives a smooth gliding joint, so frequently emphasized by the late John B. Murphy. The range of motion is excellent, the strength approaches normal, the stability is normal, and the joint is painless and tends to stand rather severe work without showing arthritic changes.

To my mind, therefore, the operation of arthroplasty on the elbow is to be considered in a different category from the old operation of excision. However, I wish to emphasize four important points: first, the necessity for the proper selection of the case; second, careful preparation for operation; third, strict adherence to the technique of the operation; and, fourth, proper after-care. No arthroplastic method should be attempted until 2 years after an infectious process has been quieted down, and until at least 1 year after a traumatic ankylosis. These two groups include fractures, infectious arthritis, and a few neisserian joints.

Ankylosis of tuberculous origin requires other treatment, and arthroplasty is indicated in only the most unusual case.

There have been more arthroplasties on the elbow than on any other joints. One of the early cases of arthroplasty using a muscle flap was reported by Albarran (2). Ankylosis had followed operative reposition. A partial resection was done by which a good immediate result was obtained, but later ankylosis occurred again. A third operation was undertaken, which consisted of a resection of the olecranon and interposition of a muscle-fascia

flap of the triceps. After 2 years there was a range of motion from 65 to 115 degrees.

Nélaton (123), in a case of ankylosis following neisserian infection, resected an elbow and interposed a flap of the brachialis anticus. Two years after the operation, flexion and extension were normal, but pronation and supination were much decreased. Active extension required the weight of gravity.

In 1903, Quénu (146b) reported an arthroplasty of the elbow for an ankylosis following a severe trauma of the arm, consisting of a fracture of both bones of the forearm and destruction of the soft parts. After resection he interposed a tendon fascia flap. There resulted flexion to a right angle and good but incomplete extension. There was good pronation, but difficulty in maintaining an intermediate position. The patient died of pulmonary tuberculosis a few months after the operation.

Delbet (50, a) also reported mobilizing, in a girl of six, an elbow which had become ankylosed in infancy, resulting in complete atrophy of the arm. At his first operation he resected the joint without breaking up the ankylosis. Two months later, after re-ankylosis, he intervened again, removing the bony spicules that had formed 0.5 centimeter thick, from the humerus, radius, and ulna. Some fibers of the flexor carpi ulnaris were interposed. Chloroform mobilization was necessary a month later, but the final result was good, with flexion to a right angle and extension nearly complete.

Schanz (162), in 1904, reported a mobilization of a bony ankylosis following rheumatism. After chiseling through the joint, he enlarged the sigmoid fossa, removed a piece of the trochlea, and interposed a flap of fat from the under side of the forearm. Three months after the operation the arm could be used for ordinary purposes.

Murphy (120, a) first mobilized the elbow by his method in 1904, in a case of ankylosing arthritis. A pyriform flap of deep fascia was dissected from the posterior surface of the triceps. The flap was 4½ inches long by 2 inches wide at its upper end, and received its blood supply from a broad pedicle which remained attached to the muscle and fascia just below the level of the olecranon. After the bony parts had been remodeled, the fascia was drawn down and turned into the joint around the inner margin of the olecranon. The proximal portion of the flap covered the trochlea, lined the olecranon depression and the lesser sigmoid cavity, while the distal portion covered the external condyle. Subsequent events showed that the flap was not carried sufficiently high on the anterior surface of the humerus to permit adequate flexion of the joint. Five months later, the patient could pass his hand through an arc of 5 inches. Pronation and supination were about one-half normal. His second case was reported 2 months after operation. The hand could be moved through an arc of 3 inches and the elbow forcibly flexed to an acute angle and extended to 160 degrees. Pronation and supination were approaching normal.

Hoffa (86), in 1906, reported a series of arthroplasties, seven of which were on the elbow. One, using a magnesium plate, was unsuccessful, owing to formation of gas in the joint. A fistula resulted which closed only when the plate was removed. The operations in which fat, fat and fascia, and fascial flaps were used were all successful. In two of them, ankylosis followed scarlatina; in the others, gonorrhœal infection.

In 1905, Quénu (146, c) reported a third case in which there was great atrophy of the muscles. He used for a flap the inner part of the triceps sutured to the anterior ligament. Passive movements were begun in 10 days, and later electrical treatment was used. As active movement was incomplete at the end of 2 months, he made a second intervention to recover a part of the tendon of the triceps, of which a large portion had been sacrificed. He cut the portion interposed close to the bone. He could then ascertain that there was no adherence between the superior surface of the interposed segment and the inferior cut surface of the humerus. The same condition existed on the inferior surface. The tendinous segment had left a distinct cavity. The tendon of the triceps was sectioned and reinserted on a little fibrous flap previously dissected on forearm. Patient gained not quite complete extension, and flexion to right angle.

Dupuy (56), in 1905, reported five arthroplasties. Three were done by Jeannel, one by Kirmisson, and one by Launay. Jeannel used flaps of the brachialis anticus; Kirmisson, of the biceps; Launay, a flap from the anterior ligament and the brachialis anticus. In all cases good results were obtained.

Huguier (94, a), in 1905, reported two cases operated on by Nélaton with the interposition of a muscle flap. In one case he gained good motion. Huguier reported a third case by Ombrédanne, using the same method.

Pereira (135), in 1906, in an unreduced subluxation, resected the ends of the bones and interposed a flap of triceps muscle, with an almost perfect functional result.

Scudder (166), in 1906, 1907, and 1908, reported several successful cases in which he used Murphy's method.

In 1907, Bazy (12) reported a case in which he used a flap from the brachialis anticus. Nine months later, the function of the arm was almost perfect.

Ameyaga (5), in 1907, brought his method of treatment to general attention. The two main factors of his technique are the formation of a new socket in the humerus and the firm grasp of the humerus by the hook of the ulna. One difficult case he reported had a good success, the patient in 3 years working in a factory and carrying heavy weights.

Stein (173), 1907, cited three successful cases from Bier's clinic. Triceps flaps were used.

Wiener (194), in 1909, treated an elbow ankylosed as a result of fracture. A flap of fascia and subcutaneous fatty tissue from the triceps was inserted. Twenty days after operation, he broke up the adhesions. Eighteen months later, the patient could carry heavy bundles, and motion was improving.

Huguier (94, b), in the same year, mobilized an elbow, using a flap of brachialis anticus. In 16 months, the patient could touch his shoulder with the hand and extend the forearm to 150 degrees.

Cifuentes (35) reported, in the same year, a similar arthroplasty in which, 1 month after the operation, he obtained a good functional result, with normal movements.

Reiner (149), in 1910, reported a series of twenty-eight arthroplasties, twenty-five of which were given in full, with the after-results. Two others, recent cases, were reported with good immediate results. In three cases the histories were unknown. Of the others, nineteen had useful arms, although one was a flail joint which lacked power, but could be controlled by the muscles. The poor results in the other cases were due to extreme atrophy of the muscles, and to extensive resection of the diseased tissue. Re-ankylosis occurred in two cases. In one, it was due to operation too soon after trauma, a fracture luxation, and lack of after-treatment. In the other case, Reiner attributes the result to the disease, myositis ossificans.

Thom (179), in 1910, reported a case of ankylosed elbow operated on by Ritter. He used freely transplanted fascia lata as an insert after the parts had been made freely movable. On discharge there was 65 degrees flexion and 100 degrees extension. Pronation and supination, which were very slight before the operation, were unchanged.

Wille (195), in 1911, interposed supinator longus fascia, with good results, gaining 95 degrees motion.

Osgood (131), in 1911, reported a case of elbow operation, using Baer's membrane. Four months after operation, extension was complete, there was voluntary flexion to 120 degrees, and a little more than normal "lateral mobility." (Just what Osgood means by "lateral mobility" is hard to understand, as a good arthroplasty has none.)

Whitman (193) reported two cases of arthroplasty of the elbow in which he used Murphy's method.

Edmunds (59), in 1912, reported an elbow ankylosis following fracture, in which this method was also used. At the time of the report, active motion was not possible, on account of the great atrophy of the muscles.

Denk (51) reported two of von Eiselberg's cases, in which elbow joints were mobilized with free fascia transplants, with good functional results.

Neff (122) reported a case in which he interposed a pedunculated triceps aponeurosis flap between the humerus and ulna and the radius and ulna. Seven months after the operation, there was active painless motion of 180 degrees

and 30 degrees, and only slight lateral mobility. The joints of the wrist and hand, which were previously partially ankylosed, regained from one-third to one-half their normal range of mobility, with the return of function to the elbow.

Delbert (49), in 1912, reported having done nine resections of the elbow with articular grafts. Most of these were too recent to determine the results, but he reported in detail two cases of a year's duration in which the results appeared to be permanent. In one of these, he used cartilage from an ankle joint; in the other, cartilage from an elbow. Both gave good functional results.

Chaput (32, a) reported three cases in which he resected from the thigh a flap of fat the size of the palm, and encapsulated the lower end of the humerus with it, suturing it to the neighboring muscles by anteroposterior and lateral sutures.

Conrad (37), in 1912, published a dissertation on the use of muscle flaps as interposing material. I have been unable to obtain a copy of this thesis.

Pomponi (141) advocated the use of a pedunculated fascial flap by the method of Durante. He cited one case in which he gained complete pronation and supination, nearly normal extension, and flexion to 60 degrees.

Murphy (120, b) reported twelve arthroplasties on the elbow, using pedunculated fat and fascia flap.

Mauclaire (112) mobilized an elbow, using cartilage from the astragalus to cover the defects. One fragment was put on the lower end of the humerus and another between the radius and ulna. A roentgenogram later showed these grafts fused to the bone.

Putti (145, a), in 1913, reported his arthroplasties to date. These included twelve elbow cases in which he used Kocher's incision and a free flap of fascia lata. He obtained stable joints, with a useful degree of motion.

Roepke (156) reported ten cases of ankylosis of the elbow in which he did arthroplasties, using free fat flaps to interpose between the joints. He advised against beginning passive motion too soon. One case of arthritis deformans was shown in 1911 before the Medical Society of Jena. In others, the ankylosis had resulted from trauma, neisserian infection, and tuberculosis.

Exner (62) reported a case 14 months after an arthroplasty in which a free flap of fascia lata was interposed. The arm was somewhat unstable, but gave good function. The patient could lift heavy weights. At the same time Pupovac reported a second case by the same method.

Darling (43) reported an arthroplasty with the use of a pedunculated flap done in the presence of active infection. The immediate result was good.

Harris (79), in 1914, reported two elbow cases by the Murphy method. In one he gained 75 degrees motion. In the other there was 60 degrees motion.

Turner (184) reported an arthroplasty of the elbow for an ankylosis following a severe osteomyelitis. There had been a musculospiral paralysis from which the patient made a perfect recovery. The elbow had entirely healed, but, at the time of operation, a small area of latent infection was found. Turner used a posterior skin incision and inserted a flap of fascia lata. The elbow was put up in extension. The next day there was a recurrence of the paralysis with signs of local infection. Later, fearing re-ankylosis, he manipulated the elbow under ether into extreme flexion. Six months later, the boy had motion from 50 degrees to 120 degrees, and a useful arm, though the muscles were still atrophied.

Murphy (120, c), in the same year, cited two cases operated on by his usual method. One patient left the hospital in 5 weeks, with free flexion and extension within an arc of about 45 degrees. The other patient, one year after the operation, had motion to 120 degrees.

Vulpius (188) prefers pedunculated flaps, but also uses free flaps of fat, or fascia and fat, or Baer's membrane.

Durante (58), in 1914, interposed a flap of the sturdy aponeurosis taken from the forearm. This method is indicated particularly in extended and hyperextended ankylosis and in cases at a right angle.

Simon (171), in 1914, in operating for ankylosis in a position of extension of about 170 degrees, used a longitudinal incision and a

pedunculated flap from the fascia of the upper arm. The result was the ability to bend the elbow almost to a right angle and to extend it at least to 170 degrees.

Payr (134, a) emphasizes the importance of removing the capsule, or at least the synovia as well as the fibrous cartilage. He has met with secondary dislocations and loose joints only in some of his first knee cases. The initial gain in motion is preserved, or even increased, with use. He had trouble with persistent swelling, especially in cases where this had existed for a considerable time before operation, or had been marked. He believes convalescence is shortened by waiting until the swelling has subsided. If re-operation is needed, he advises waiting at least 6 months. In 1914, his first case was 4 years old. He reports twenty-two arthroplasties, of which three were elbows, one with a good result and two with very good results. He believes that, if the indications are correct and the technique and after-treatment good, a favorable result is to be expected in 70 to 80 per cent of the operations.

Pupovac (144) reported a case of a girl of nineteen whose elbow had become ankylosed at 130 degrees as the result of a severe arthritis. He did an arthroplasty, using a posterior incision and a free fascial flap, and gained motion from 105 degrees to 140 degrees. Five months later, he reopened the joint and removed some exuberant bone that united the humerus with the ulna. He gained 70 degrees to 130 degrees motion.

Davis (46) thinks that we should be conservative about opening a joint ankylosed by tuberculosis. He finds the elbow one of the most satisfactory joints for an arthroplasty, as well as for an excision, but the results with the former are much more satisfactory. An excision requires the removal of 1 to 1.5 inches of bone to ensure movement, but, with an arthroplasty, only sufficient bone need be removed to interpose the flap, and it is almost certain to give a stable joint. He used two pedunculated flaps, one from either side. The joint, he believes, should have drainage.

Murphy (120, a) reported in 1915 a case of ankylosis following fracture. The elbow was ankylosed at about 150 degrees with a few degrees of motion. Seven weeks after operation, there was good pronation and supination, and perfect freedom of motion.

Ashhurst (7) uses an incision along the external supracondylar line and the external condyle, detached from the humerus with an osteotome. A pedunculated flap is inserted, and the external condyle replaced by means of a Lambotte self-boring screw. He reports five cases. In these cases there were three good end-results. One case had a flail joint with very slight power of extension. The fifth case had a limited motion, but the patient refused forcible manipulation.

Gilbert (68) cited a case of dislocation of the elbow which had existed 3 months. Good use of the joint was obtained after a Murphy arthroplasty.

Tubby (182, a) reported one elbow case in which he used a muscle flap. At the time of the arthroplasty, insufficient bone was removed and re-ankylosis took place. Eight months later, he did a secondary operation to remove the mass of new bone. After this intervention, all movements were free, but the elbow was slightly flail.

Chaput (32, b) reported a case of arthroplasty for ankylosis following luxation of the elbow. He used two lateral pedunculated flaps and sewed the skin up tight. The arm was put up in a sterile dressing in extension. The following day the arm was flexed, and flexion was complete and vigorous. He attributes the good result to sewing up the wound without drainage and to the immediate mobilization.

Graff (73) described a case in which he interposed a flap of triceps muscle with almost complete return of normal motion.

Kennedy (98) cited a case in which a pedunculated flap was used. The end-result is not reported.

Murphy (120, d) reported a case showing perfect motion 7 months after arthroplasty for ankylosis from a fracture. A second ankylosis from tuberculosis showed a good end-result.

Whitman (193) exhibited before the New York Surgical Society a case in which an arthroplasty had been done for a fibrous ankylosis following tuberculosis. Four years before, an arthroplasty had been done using a

pedunculated flap. At the second operation, the fibrous ankylosis was found to have become bony. Whitman used a flap of fascia lata at this operation. He believes that, in an ankylosis following tuberculosis, a free fascial transplant is essential to success, as the tissues about the joint are atrophied. His case showed a perfect end-result, with normal flexion and 165 degrees of extension.

Brown (22) gained 80 to 150 degrees of motion in an arthroplasty by the Murphy method. The arm had been ankylosed in extension following acute metastatic arthritis.

Rovsing (159) reported before the Northern Surgical Society two successful cases in which the Murphy method was used. The ankylosis was the result of fracture. In the discussion, Bergman and Haglund expressed the opinion that mobilization of the knee should not be attempted.

Moszkowicz (119), in his report in 1916 on his operation on war injuries to joints, gives among other cases six elbow arthroplasties. In all of these a useful degree of motion was gained.

Ringel (151), in 1916, mobilized five cases of complete ankylosis of the elbow and implanted fat and fascia flaps. One good result was obtained; three cases were being treated when he reported, and in the other case suppuration developed.

Four cases of mobilization of the elbow, in which flaps of fat were interposed, were reported by Werde (190), in 1916. He obtained normal motion in all cases.

Steindler (174), in 1916, reported two operations. In one of ankylosis of the humerus, a pedunculated muscle flap was used. Mobility was good as long as the patient was under observation. The end-result is not reported. The other case followed fracture of the head of the radius, resulting in partial ankylosis. A pedunculated fascia flap was inserted. In two weeks range of motion was about normal.

Crosti (41), in 1916, presented a case in which he had interposed an aponeurosis flap taken posteriorly from the forearm. Complete bony union at an angle of 130 degrees was a result of fracture from a shell. There was a vast amount of cicatrix. The olecranon was temporarily detached according to Durante's process. To ensure pronation and supination, he interposed a small muscular flap between the radius and ulna according to the process of Huguier. The olecranon was nailed in place. Movements were started in 10 days. In 8 months there was complete active extension, flexion at an angle of 40 degrees, good movement, pronation was somewhat fettered, and supination was restored.

Plummer (140) reported two arthroplasties in which he used pedunculated fat and fascia flaps. One of his cases became infected, and subsequently a portion of the end of the humerus had to be removed. The resulting joint was somewhat flail, but gave good function. His second case also had good motion, but facility for moving joint was not good.

Ryerson (160) gives in detail his operative technique in arthroplasty on the elbow joint. He uses a long posterior incision, avoiding the olecranon. The triceps tendon is cut and a thin shell of bone is removed from the external condyle, taking the origin of the extensor with it. Then a shell from the internal condyle is removed. The joint is dislocated. After it is remodeled, a flap of fascia lata is interposed.

Thomson (180) reports the end-results in an elbow arthroplasty by the Murphy method. Ankylosis was the result of sepsis following a fracture. Seven months later, elbow motion was good, but somewhat restricted. His successful cases have all been traumatic. He believes that neisserian infection is a contraindication to arthroplasty, as it stimulates bone formation. Tuberculosis is also a contraindication, on account of the recrudescence of the disease.

A brief mention is made by Prando (142) of a case using a modification of the Murphy method. He did not use an Esmarch bandage, and enveloped the ulnar nerve in a flap of muscle taken from the triceps. He is satisfied with his results. He also reports a case in which Padman followed the Murphy method. Satisfactory motion was obtained, but later the joint re-ankylosed. Prando believes that the Murphy method is very good, although it cannot be so successful as orthopedic resection, on account of the great danger which the slightest negligence involves.

Ceccarelli (31) used strips of fascia lata in an arthroplasty on a post-traumatic ankylosed elbow. The end-result was perfect flexion, extension to 165°, and almost normal pronation and supination.

Olivieri (128) reports two arthroplasties with interposition of strips of brachialis anticus. The end-results were perfect.

Hohmann (89), in 1918, reported five elbow arthroplasties in which he inserted part of the triceps with good immediate results. Lange at the same time showed six cases in which useful joints were obtained and the patients were enabled to resume their old occupations. He used fat or muscle flaps.

Baer (9,a), in 1918, reported having done to date three arthroplasties on the elbow joint. In one, re-ankylosis occurred, one patient died, and the third showed 25 degrees motion. He believes that the elbow is the least favorable joint for arthroplasty, and that the success from the interposition of muscle or fascial flaps is due to the amount of bone removed rather than to the flap itself, and that these operations are in fact only excisions. In the discussion of this paper, Galloway and Freiberg express the opinion that an arthroplasty has no advantage over an excision. Davis states that with an arthroplasty a more stable joint is obtained.

Albee (3) uses a vertical incision directly over the olecranon. After retracting the ulnar nerve and dissecting the soft tissues, he saws through the olecranon from within outward. He remodels the joint and interposes a flap of fascia lata containing as much fatty tissue as possible. The arm is put in plaster at right angles. After 10 days, passive motion is begun.

Henderson (81), in 1918, tabulated the end-results of the forty-three arthroplasties done at the Mayo Clinic. Twenty-one of these were on the elbow. He found the prognosis most favorable in the jaw and next in the elbow. The knee was the most unfavorable position. In reports from other surgeons he found a general agreement as to prognosis.

Kleinschmidt (102), in 1919, demonstrated two cases in which he secured mobility, using Payr's method. One case of complete ankylosis had resulted from a shot wound and the other from acute rheumatism. Good active and passive motion to a sharp angle were secured, extension was complete, and pronation and supination amounted to 60 degrees.

Grange (74), in 1920, used a flap of fat from the posterior surface of the triceps and a piece of cargile membrane on each side of the flap in an arthroplasty for complete ankylosis of the elbow at an angle of 90 degrees. The joint was reached through an incision 4 inches long on the outer and inner side of the joint and a transverse incision across the arm above the olecranon. The ulnar nerve was dissected, the triceps muscle divided, and the humerus exposed. Flexion of 30 degrees beyond a right angle and extension of 45 degrees from a right angle were secured. The pronation and supination amounted to about 30 degrees, due perhaps to too little excision of bone.

Kerr (99) cited a case of complete ankylosis of the elbow following arthritis. He used Kocher's incision and inserted periarticular fascia. The result was a movable, useful joint, with no atrophy of the muscles.

Verral (187), in 1920, described his method of operation. He makes an eight-inch incision along back of the elbow. The triceps tendon is divided in two layers to overlap when sutured. A fascia flap is sutured over the end of the humerus. The elbow is put at about 120 degrees.

Rocher (153), in 1920, applied Putti's technique, using a flap of aponeurosis fascia lata in operating for a case of fibrous ankylosis of the elbow in an almost rectilinear position. He secured a perfect functional result of voluntary flexion to 80 degrees and pronation of 45 degrees.

Silfverskiöld (170), in 1922, reported an arthroplasty, using flap of fascia lata. In eight months the patient showed full active capacity for flexion and extension.

Campbell (26,b) has just published his method for arthroplasty of the elbow, which is evolved from his method for reduction of old dislocations. An incision 6 to 8 inches long is made on the posterior aspect of the arm and forearm. The skin and fascia are incised and the deep fascia dissected laterally about one inch. The suture is then dissected downward, making a long tongue flap.

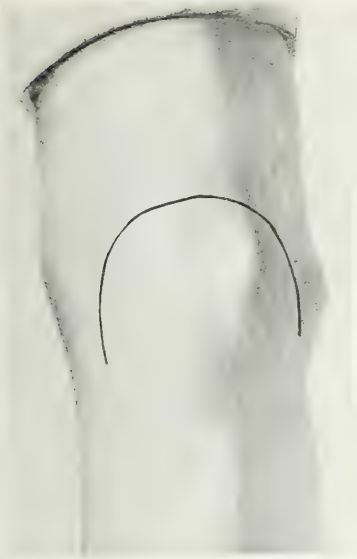


Fig. 1. Line of incision used by the author.

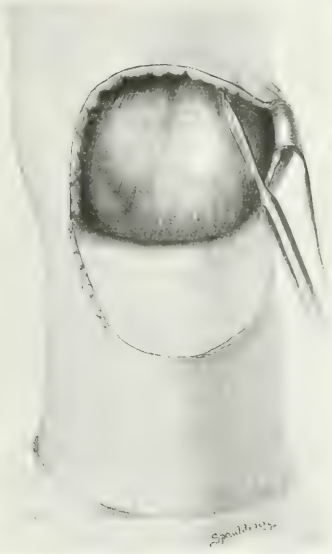


Fig. 2. Dissecting out the ulnar nerve.

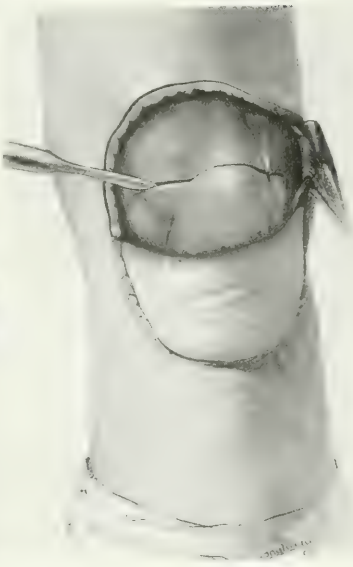


Fig. 3. Cutting through the muscle and fascia down to the joint.

Through a further incision the periosteum is stripped from the lower third of the humerus. A half-inch of bone is removed from the humerus and the end modeled into a surface convex from before backward. A half-inch of bone is then removed from the tip of the olecranon process. The surface of the head of the radius is made the same level as the coronoid process. The periosteum and triceps are dissected into a double flap, which is stitched to the anterior capsule. One case of ankylosis as a result of acute infectious arthritis, operated on by the above method, in 6 months resulted in complete extension

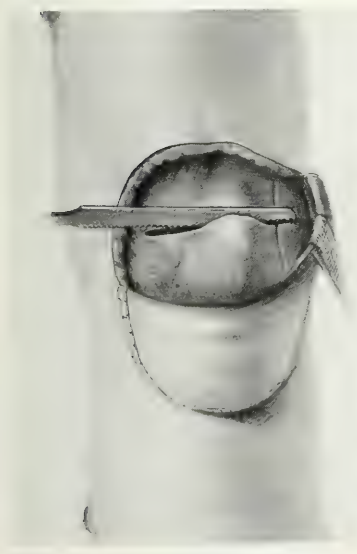


Fig. 4. Sawing through olecranon and end of humerus.

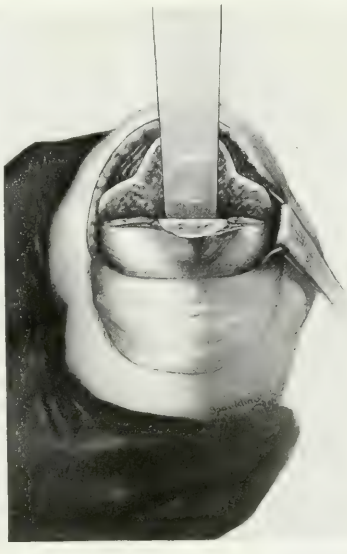


Fig. 5. Splitting off tip of olecranon with chisel.

Fig. 6. Removing with rongeur forceps bit of olecranon tip left in humerus.

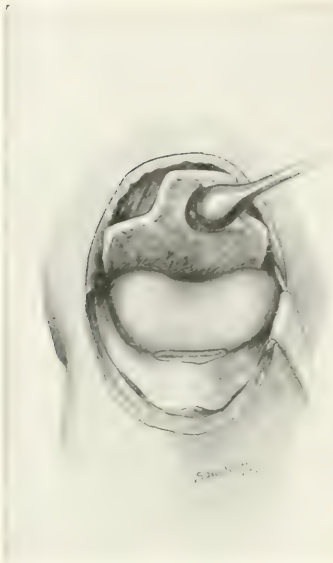


Fig. 7. Scooping out ulna and radius with curette.

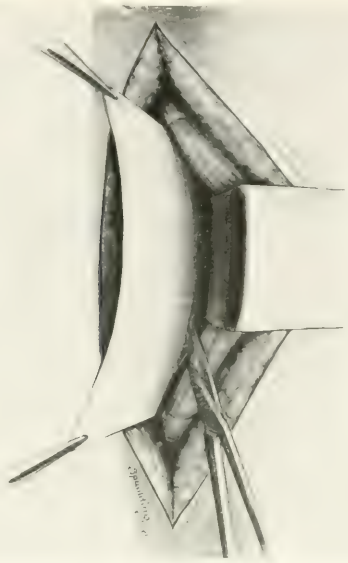


Fig. 8. Cutting fascia lata from thigh.

Fig. 9. Sewing flap of fascia lata to elbow joint anteriorly.

with flexion to 60 degrees. Physiotherapy is being used to increase the flexion.

In case of a normal radio-humeral joint with bony ankylosis between the ulna and humerus, a hemi-arthroplasty is done between the humerus and ulna and a broad aponeurotic tongue flap from the triceps interposed. The one case reported, of solid bony ankylosis, in six months resulted in 50 per cent of the normal motion.

The after-treatment is very important, and active motion is essential.

Operative technique—author's method. The arm from the wrist to the shoulder and the leg on the same side, from the hip to the knee, are given a two-day preparation. At the time of the operation, a tourniquet is applied to the upper third of the arm and an application of iodine made to the skin.

A semicircular incision is then made, beginning over the external condyle (Fig. 1), running down about two inches and up over the internal condyle. The wound is sponged with alcohol and carefully clamped off to avoid handling the skin during the operation. The flap containing skin and superficial fascia is then dissected back to the base line and retracted. The ulnar nerve is isolated and dissected out of its sheath (Fig. 2). It is sometimes difficult to find this nerve, but it is always to be sought at the inner side of the internal condyle. It should be dissected out carefully with a blunt dissector so as not to injure it. After it has been freed for one and one-half inches, gauze is passed beneath the nerve, and it is retracted to the ulnar side. It is then freed further by blunt dissection with gauze.

A transverse incision is then made extending down through the periosteum (Fig. 3). This incision follows in direction the superficial one, and outlines a flap which is to be dissected back and preserved *in toto* for subsequent covering for the joint. The pulling back of this flap is a hard and tedious process until it is well started, after which it can be peeled back readily by blunt dissection. It is the inner side that is the hard part, as the layer is thin here, and one must exercise great care not to buttonhole it. The olecranon is then sawed through (Fig. 4). After this, it is frequently possible to break open the old joint. In some cases, however, ankylosis is bony and the joint cavity obliterated. Cases of this kind are the most difficult. It is in these cases necessary to saw through the joint. The tip of the olecranon has to be chiseled out and dissected back with its posterior flap. Usually

Fig. 10. Fascia sewed over humerus; tied with chromic catgut suture.

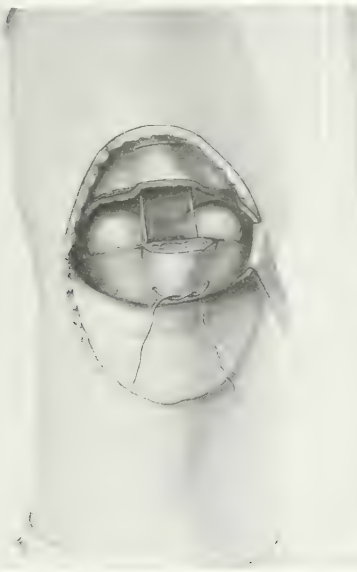


Fig. 11. Kangaroo suture through ulna and olecranon tip.

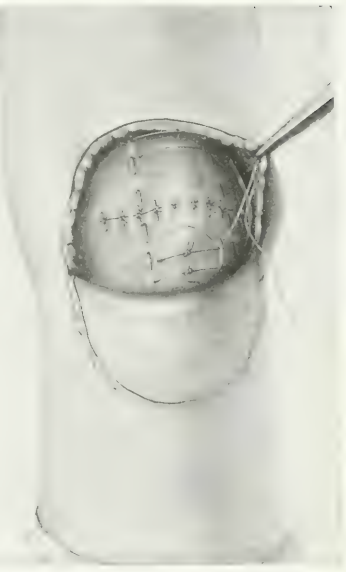


Fig. 12. Stay sutures.

the olecranon is too large, and it is well to take off a little of it (Fig. 5).

The capsule, fascia, and ligaments are then dissected back so as to allow the lower end of the humerus to protrude into the wound. Then its edges are snipped off with rongeur forceps and a new trochlear or intercondylar surface formed (Fig. 6). A shoemaker's rasp is used in filing the extremity as near like the normal humeral end as possible. After this modeling, a piece is removed corresponding to the olecranon fossa in the normal humerus. One has to be careful about making this cup, as the success of the operation depends largely upon attention to such small details (Fig. 7). This modeling is largely done with a saw and a file.

To ensure good function, the joint surfaces should fit accurately before the fascia is applied, but the joint should not be too loose. Only sufficient bone must be removed to give free motion. If too much of the ends of the bones is removed, a flail joint will result, giving the operation no advantage over an excision. When this mortising is completed, the fascial flap is dissected from the leg (Fig. 8). An incision is made on the outer side of the thigh, a little below the middle, extending down to the fascia lata. After a flap of fascia 5 to 7 inches by 4 to 5 inches wide is dissected out, the wound is closed.

This fascia, which is free from all fat, is placed about the newly fashioned humeral condyles and attached anteriorly to the capsule (Fig. 9) and posteriorly to the periosteum of the lower end of the shaft of the humerus with interrupted chromic catgut sutures No. 2 (Fig. 10). Chromic catgut No. 2 is then loosely wound twice around the shaft just below the interrupted suture line.

The forearm is placed in apposition to the condyles. Two drill holes are then made in the olecranon process and two others opposite them in the shaft of the ulna. Through these kangaroo tendon is passed and tied (Fig. 11). The inner layer is now sutured with chromic catgut No. 2 and the skin and fascia with plain catgut No. 2 (Fig. 12). Dry sterile dressings are applied and the arm put up in plaster beyond a right angle.

After-treatment. If there is no evidence of infection, the cast should remain on for a week. It is then split and the dressing changed. If there is a persistent temperature, a window should be cut in the cast and the wound inspected.

Passive motions are begun in about 10 days, if normal healing has taken place. The arm is

Fig. 13. Case 1. E. S. Roentgenogram showing position of ankylosis before arthroplasty.

always kept above a right angle. After 3 weeks, gentle massage is applied. Baking is begun in 6 weeks, three or four times a week.

The ultimate success in these cases depends very largely on the after-treatment. The patients should be under observation for a long period of time. Frequent X-rays should be taken so that we may follow the bony changes in the joint. If motion begins to shut down, the arm should be manipulated under an anæsthetic and the elbow put up in acute flexion. Occasionally motion becomes limited, due to an exuberant growth of new bone. In this case, a secondary operation should be done to remove this, but it should not be undertaken for at least 3 months after the original operation.

Case 1. E. S. was admitted to the Carney Hospital, August 11, 1913, for immobility of the right elbow and right knee. Six years previously, the patient had had an acute illness accompanied by fever and pain and swelling in the joints, for which she was treated in her home, without relief. At the end of 8 months, the pain and swelling had disappeared from her left shoulder and elbow so that she was able to feed herself, but she remained in bed for 12 months and after this was in a wheel-chair

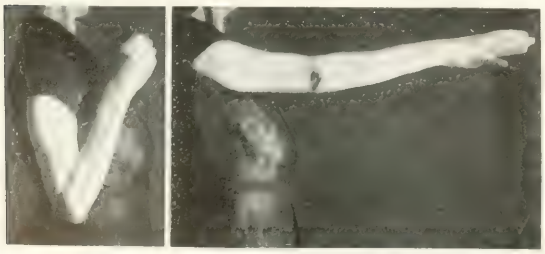


Fig. 14. Case 1. E. S. End-result, 5 years and 10 months after arthroplasty. At left, voluntary flexion; at right, voluntary extension.

Fig. 15. Case 1. E. S. Lateral roentgenogram, 5 years, 10 months after arthroplasty.

for 2 years. The symptoms continued to subside and the pain and swelling disappeared; fairly good motion returned to all the joints except the right elbow and the right knee, in which pain and stiffness continued at the end of the fourth year, and no motion was possible. This condition continued up to the time of admission.

August 14, 1913, roentgenoscopy revealed an ankylosis of the elbow joint and of the patella to the femur (Fig. 13).

August 20, 1913, I did an arthroplasty of the right elbow using a flap of fascia lata. A light plaster cast was applied. Following the operation, the patient made a good ether recovery. There was slight pain in the elbow.

August 27, 1913, the cast was split for dressing.

September 1, 1913, the wound had healed by first intention except for a slight discharge on the upper border.

September 4, 1913, daily manipulation of the elbow was ordered.

September 10, 1913, the arm could be extended completely and flexed to 15 degrees beyond a right angle.

September 15, 1913, traction was applied for flexing and extending the arm.

October 1, 1913, active motion was possible.

October 15, 1913, I manipulated the arm under ethyl chloride.

May 15, 1919, 5 years and 10 months after operation, she writes: "The arm is doing excellent work." Photographs taken at this time show practically full extension and flexion (Figs. 14 and 15).

Case 2. E. S. sustained a fracture of the right elbow on October 4, 1913, as the result of a fall of 42 feet. The roentgenogram showed a transverse fracture of both condyles with the radial head dislocated laterally and anteriorly.

Physical examination was negative except for the right arm. The shoulder appeared normal. The elbow was held at 150 degrees extension with less

than 3 degrees motion. Supination was limited one-fourth. The wrist showed a Colles fracture unreduced. Flexion and extension were both one-half normal. Eversion was limited three-fourths and inversion four-fifths (Fig. 16).

On March 25, 1914, I did an arthroplasty on the right elbow, using a flap of fascia from the thigh. When the joint cavity was opened, it was found that the synovial tissue was hypertrophied, and there was much fibrous callous formation infiltrating the articular surfaces. A transverse fracture of both condyles was noted. The head of the radius was impacted, and was surrounded by callous formation.

Five-eighths of an inch of the condyles was sawed off square at right angles to the shaft of the humerus. The joint surfaces were smoothed off and the operation completed according to my usual method. The arm was put up in plaster in an extended position. The patient made a good ether recovery, but suffered considerably from pain, for which morphia was ordered, and the following day the arm was put up in suspension. He continued to suffer considerable pain for 4 days, after which it abated.

On March 29, 1914, the wound was dressed, and was found clean except for some serous discharge.

March 30, 1914, the cast was split and a voluminous dressing applied with splints to the forearm.

March 31, 1914, the patient was seen in consultation by Dr. Courtney, who reported a tourniquet paralysis, and advised electricity and massage.

April 1, 1914, the wound was dressed, and found clean and healing by second intention. Electricity and massage daily.

April 5, 1914, the patient was out of bed and walking about the ward. When dressed, the wound was found clean.

April 10, 1914, the wound was dressed. The motion in the elbow was good, with supination and about 45 degrees motion in flexion. A nerve report was ordered.

April 15, 1914, the nerves were reported responding to the faradic current. The prognosis was considered good. Massage was advised.

April 18, 1914, the patient was discharged from the hospital to report daily at my office.

November 30, 1914, the patient re-entered the hospital for operative interference in an attempt to gain increased motion. Both bones of the forearm had dislocated backward and the head of the radius was very much enlarged. Motion was from 150 degrees extension to 50 degrees flexion with the carrying angle markedly increased.

Fig. 16. Case 2. E. S. Roentgenogram showing ankylosis before arthroplasty.

On December 2, 1914, after the usual preparation, a four-inch incision was made over the external condyle. The removal of the enlarged head of the radius caused a marked increase in motion, but the posterior dislocation was not improved. The internal condyle was chiseled loose and removed through a small incision over the fragment. After the end of the humerus was smoothed as much as possible with a rasp, the wound was closed and a cast applied with the arm at right angles. A good ether recovery followed.

After the operation, the patient suffered considerably and showed some swelling of the arm. On the fourth day, the cast was split, and the patient experienced relief.

On the seventh, the patient was comfortable and out of bed. The following day he was discharged, to report to my office.

The end-result shows nearly normal range of motion with a stable, useful joint.

On October 29, 1920, he writes: "I can crank a Ford. I can do anything that I ever could. My work is driving and repairing automobiles, and I have had to change 38–7 tires on the road, which requires the use of two good arms." (Fig. 17.)

Case 3. F. D. In 1910, the right elbow became swollen and tender. At this time an open operation

a. b. c.

Fig. 17. Case 2. E. S. End-result, 6 years, 6 months after arthroplasty. a, voluntary flexion; b, voluntary extension; c, range of motion.

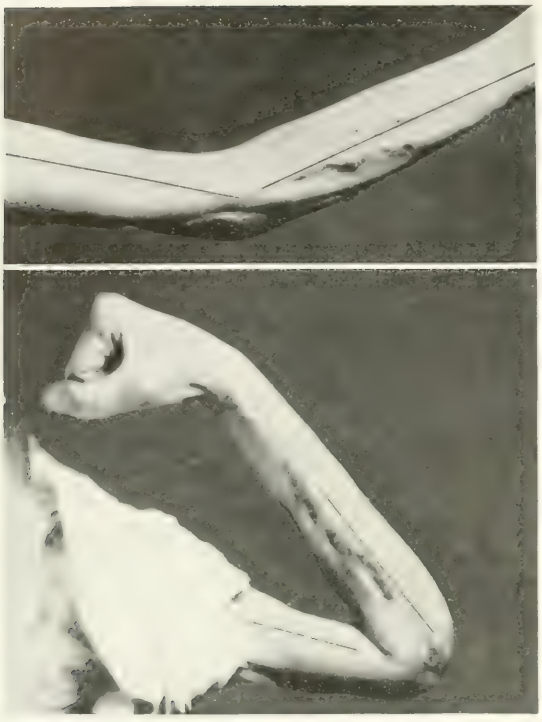


Fig. 18. Case 3. F. D. End-result, 1 year and 4 months after arthroplasty. Below, voluntary flexion; above, voluntary extension.

was done on the joint. Six months later, another operation was done after which the elbow drained for 4 years and the patient lost the entire use of the arm. There were numerous scars above and about the elbow. The elbow was ankylosed at 180 degrees. Finger and shoulder motions were normal.

On August 10, 1918, by the usual method, I did an arthroplasty on his elbow. He made a good recovery and had a normal convalescence. Two weeks later, he was discharged to have daily dressings done by the family doctor. Motion at this time was from 80 degrees to 100 degrees without pain.

He reported at my office on August 30, 1918. At this time the wound was quite healed. The elbow showed 30 degrees motion. He was then seen about every 6 weeks. On October 18, 1918, the wound was found healed. Motion gradually increased.

On December 9, 1919, he showed motion from 35 degrees to 145 degrees, with full supination. The elbow was stable, with no lateral motion. He has no pain, works as a telegraph operator, and "lifts anything." (Figs. 18 and 19.)

Case 4. E. M. This patient's trouble started slowly with general poor health. Two years ago, she became ill with infectious arthritis, which at first affected the knees. There was no history of a neisserian infection. The patient was very much

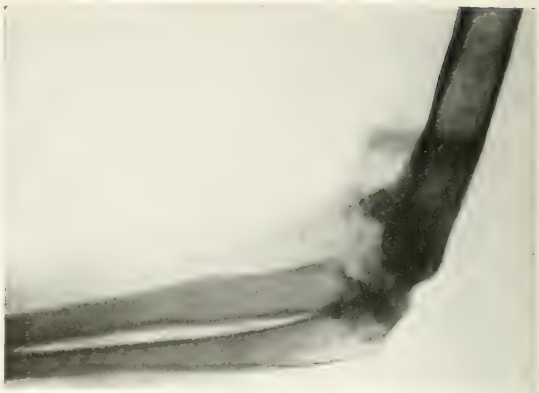


Fig. 19. Case 3. F. D. End-result, 1 year and 4 months after arthroplasty. Voluntary extension.

constipated and suffered more or less from tonsillitis. Later, the elbows became painful and could not be straightened out.

Physical examination showed a thickening of the capsule of the left elbow, with about 35 degrees limitation in motion. The left knee showed extension to within 15 degrees of full extension. The patient walked with a marked limp, and flexed knees. General treatment was prescribed, with forcible extension of the knees. As motion in the arm had shut down leaving it ankylosed at 100 degrees, an arthroplasty on this joint was advised.

February 25, 1913, I did an arthroplasty, using my fascia lata method.

March 24, 1913, the arm showed no swelling. There was little pain and the patient's general condition was fair. There was about 15 degrees motion. Gentle manipulation was ordered.

December 16, 1913, the wound had healed by first intention; supination was three-quarters normal, extension was to 170 degrees and flexion to 10 degrees to 15 degrees beyond a right angle. The patient could reach the opposite shoulder with the thumb with ease, but could not dress the lower part of the hair. The muscular power was as good as in the right arm. To gain more motion, a forcible manipulation was advised.

December 29, 1913, under ether, extension to within 5 degrees of straight was obtained and flexion to 45 degrees.

January 26, 1914, examination of the arm showed no lateral mobility and no crunching crepitation. Mobility was from 55 degrees to 145 degrees. (Figs. 20 and 21.)

Case 5. S. S. This patient was first admitted to the Burbank Hospital, Fitchburg, December 5, 1917, with a subacute neisserian infection. Five years previously the right knee had become swollen, and remained so for 3 months. A month later, the right elbow became swollen and painful. The Wassermann test was positive. She remained in the hospital 38 days, receiving general treatment, and was discharged relieved.

She returned to the out-patient department July 1, 1918. The arm was then put up in plaster from wrist to shoulder to remain on 2 months. She was told that her elbow would probably become stiff and would require an arthroplasty later.

On January 9, 1919, the patient was advised to have an arthroplasty done as her elbow had become stiff. Following the operation on February 6, she had an uneventful recovery. The cast was removed in 2 weeks, after which passive motion was begun. She was discharged March 18, 1919 (Figs. 22 and 23).

Case 6. M. R. For 13 years this patient had had attacks of rheumatism affecting the ankles, elbows, and knees. The physical examination was negative except for the joints. Both knees were slightly flexed and the right one was ankylosed, showing scars on either side. The right ankle showed some contraction of the tendo-achillis. The left elbow showed good motion except for 10 degrees limitation in extension; the right was ankylosed at 125 degrees.

The patient was admitted to the orthopedic service of the Carney Hospital, September 6, 1910, where very slight improvement took place in the knees and feet under conservative treatment. In October, 1910, on account of the swelling and bogginess of the left knee, an arthrotomy was advised. This was done October 19, 1910. Daily manipulations were begun on the fifth day, and an uneventful recovery took place as regards the knee.

As the elbow was stiff and in an ungainly position, operation on this joint was advised. On November 5, 1910, an arthroplasty by the Murphy method was done on this joint.

November 10, 1910, the right hand was considerably swollen and painful, for which pressure and hot fomentations were applied. The skin on the upper part of the arm became somewhat necrotic from poor circulation and later sloughed.

November 30, 1910, passive motion was begun and repeated daily. The first attempt at motion was made and 30 degrees attained. Following this, progress was continuous and a gradual gain in motion was made. Later, massage was ordered for the hand, forearm, and shoulder.

Fig. 20. Case 4. E. M. Above, lateral roentgenogram 10 months after arthroplasty; below, anteroposterior roentgenogram.

January 11, 1911, about 30 degrees to 40 degrees of motion in flexion and extension were obtained. The wound showed heavy granulation tissue. A week later she was discharged from the hospital. Dressings were to be done at home.

February 28, 1911, she was readmitted to the hospital for manipulation. Normal motion was obtained. Since this time, she has been seen in the out-patient department. There is practically no lateral

a. b. c.

Fig. 21. Case 4. E. M. End-result, 10 months after arthroplasty. a voluntary extension; b, voluntary flexion; c, range of motion (not in full range).

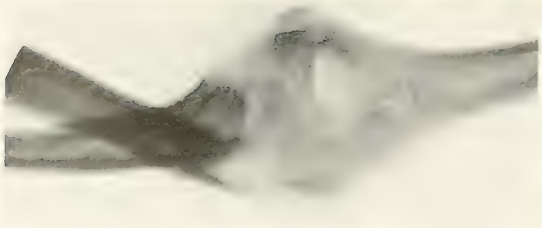


Fig. 22. Case 5. S. S. Roentgenogram showing ankylosis before arthroplasty.

mobility and the end-result is perfect function (Figs. 24 and 25).

For a full report of elbow arthroplasty, the reader is referred to the author's (111) articles appearing in *Clinics of North America*, *Journal of the American Medical Association*, and SURGERY, GYNECOLOGY AND OBSTETRICS.

KNEE

The knee joint presents a greater barrier to good arthroplastic work than any of the other large joints. Lateral stability and security in the knee must be almost absolute. Without stability, a brace is necessary to permit walking; even the use of a brace will not prevent the progress of overgrowth of bone (a direct result of undue strain), with its accompanying pain and soreness. A stiff knee, on the other hand, is a good functional member if the ankylosis is firm and in good position (5 degrees to 8 degrees of flexion). (Figs. 26 and 27.)

Fig. 24. Case 6. M. R. Roentgenogram showing ankylosis before arthroplasty.

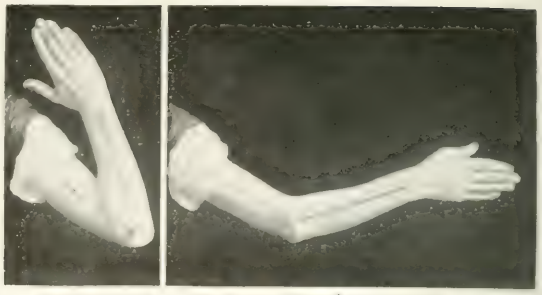


Fig. 23. Case 5. S. S. End-result, 1 year and 4 months after arthroplasty. At left, voluntary flexion; at right, voluntary extension.

If we consider arthroplastic measures in a single ankylosis of the knee, they must be cautiously advised, even in face of the advances that have been made, largely by the splendid work of Professor V. Putti, of Bologna. Arthroplasty must be done with the assurance of stability and freedom from sensitiveness and pain. In other words, we must increase function in order to classify the result as good or improved.

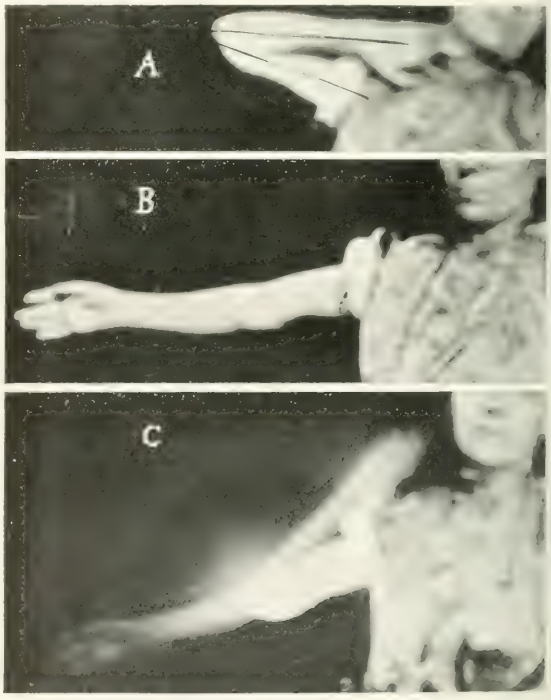


Fig. 25. Case 6. M. R. End-result, 1 year and 3 months after operation. a, voluntary flexion; b, voluntary extension; c, range of motion.

Progress is fast being made, and, although undoubtedly the last 5 years have seen a great advance in the number of functional results, we expect better ones in the future.

Generally speaking, an ankylosis, bony in character, lends itself best to mobilization, as it is more free from the results of tissue infection. Such a condition is true of all joints.

In general, the results of fascia transplantation have proved most successful, and the technique as advised by Putti has given the most consistent results. I differ from his technique only in believing it advisable not to sever or disturb the patella tendon or its attachment.

Operative technique—author's method. The usual preparation is given both legs from the ankle to the groin. I feel it is best to remove the fascia from the opposite leg, thereby minimizing the extent of the operation on the ankylosed leg as well as making it possible to remove more fascia without disturbing the external support of the joint.

The incision is made from just below the inner attachment of the patella tendon, curving slowly over this point to the middle of the external cartilage, and then directly up the outer side of the leg just above the mid-horizontal line, a distance of 5 to 10 inches from the joint proper (Fig. 28). As much fat as possible is taken with this incision. After clamping the skin-edges with towels, the skin is dissected to the inner side of the leg, exposing the patella tendon, patella, and tibial tubercle.

A curved incision is then made through the fascia, beginning in the mid-anterior line, about 5 inches above the patella, and running between the patella and outer condyle to just below the knee joint.

The quadriceps tendon is then exposed and elongated. This elongation not only allows better joint exposure, but affords a proper lengthening when we later place the leg in flexion in plaster. This lengthening may also be done by the Bennett method (Fig. 29). The patella is then raised from the femur, taking the lower cut portion of the quadriceps tendon, and forcibly retracted to the inner side of the knee, with its inner ligament attachments intact. Some surgeons detach a

Fig. 26 (at left). Ankylosis of knee, normal position.
Fig. 27. Ankylosis of knee, 30 degrees flexion.

piece of the tibial tubercle in order to increase exposure, but I have found this unnecessary when the quadriceps tendon is elongated in the beginning. There are also many difficulties when this piece is removed, such as delayed or faulty union, which complicate the convalescence (Fig. 31, see frontispiece).

The patella in these cases is often found hypertrophied and should be narrowed laterally, as well as thinned and smoothed with a shoemaker's rasp.

The joint being then exposed, a careful study of it is made from X-rays, and great care is taken to follow the contour carefully. Putti instruments are admirable for this purpose (Fig. 30).

Several important requirements must be observed:

1. Be sure to leave a well-defined spine between the tibia condyle, as well as cup out the upper tibia surface, which will help stabilize lateral mobility (Figs. 32 and 33).

2. Carefully round the condyle with a Putti instrument and a shoemaker's rasp, making a concavity to fit over the newly formed spine.

3. Actually replace these opposing surfaces, and mold carefully, without any irregular hitches during attempts to flex.

4. Cup out a space into which the patella will articulate. Great care should be taken with this modeling.

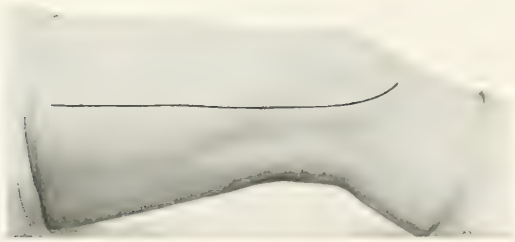


Fig. 28. Kocher's incision as used in technique employed by author.

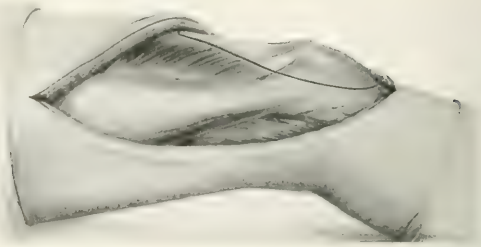


Fig. 29. Incision through fascia and capsule including division of the quadriceps tendon.[1]

5. Remove a large piece of fascia lata ample enough to cover both condyles. The fascia nearest the knee on the outer side is thickest and most serviceable. When this is removed, sew the fascia over the condyle, covering all exposed bone well. Sew posteriorly 2 inches above the articular surface (Figs. 34 and 35). The femur is then adjusted to the tibia, and the patella is replaced. The outer fascia is united with interrupted chromic catgut.

The elongated quadriceps is then strongly sutured and the skin closed with interrupted catgut (Fig. 36). A plaster is applied from the toe to the groin with the knee in 35 degrees to 40 degrees flexion and the leg placed in an elevated position in bed. Opiates are often necessary and may be freely used.

After-treatment. The temperature, pulse, and pain are carefully watched for any signs of infection.

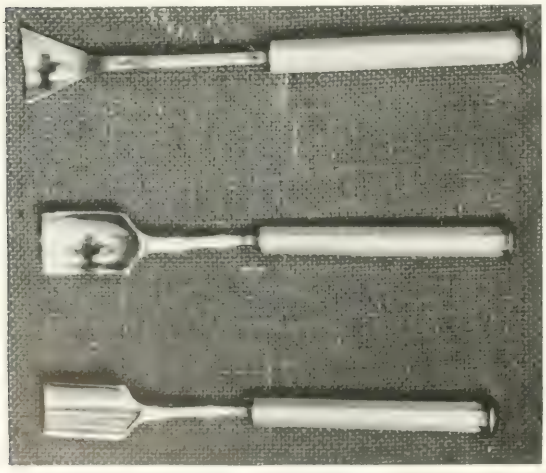


Fig. 30. Putti instruments.

The cast is split for dressing in 2 weeks and the leg put in a ring caliper with 35 degrees flexion, so arranged that this can be changed and passive motion slowly started. Traction is also applied with this caliper which remains on day and night. Gentle passive motions are started and increased gently, guided by pain and sensitiveness, which always should be minimized. Massage is started in 5 to 6 weeks for thigh and calf, and the patient may usually walk with crutches about the sixth week. By means of an overhead extension, the patient may also use passive motions in bed, two or three times a day.

Active motions are started or attempted about the tenth week, preferably with the leg submerged in a tub of water. No actual weight-bearing is allowed until the lateral ligaments have tightened, and a caliper may be applied to assist weight-bearing, depending wholly upon the sensitiveness and pain on use.

Case 1. F. O. K., age 31. In 1909, patient had an acute neisserian infection in the left knee. The opening of the joint resulted in an ankylosis. The knee was in good position, but there was no motion between the tibia and the femur. The patella was ankylosed to the femur. Manipulations were unsuccessful in obtaining motion. Arthroplasty was advised.

December 14, 1910, arthroplasty on left knee according to the technique as described.

December 23, 1910, out of bed. Daily dressings.

January 5, 1911, cast removed. Posterior shell applied.

January 7, 1911, small amount of weight-bearing. Crutches.

January 19, 1911, patient discharged from hospital. In a leather leglet with limited motion. He is to continue stretching and daily hot fomentations.

January 3, 1923, now 12 years since arthroplasty. Patient has no pain and has had no trouble. "No

[1] Figures 31 to 36, detailing further points in author's technique, shown in frontispiece.

Fig. 37. Case 1. F. O'K. Weight-bearing, 12 years after arthroplasty.

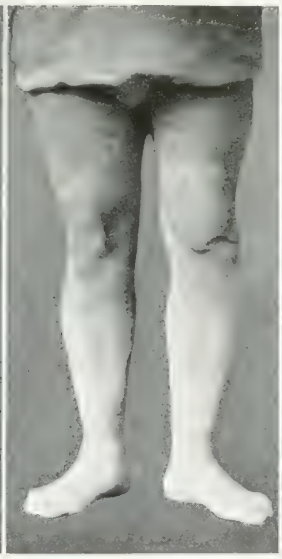


Fig. 38. Case 1. F. O'K. Weight-bearing, 12 years after arthroplasty.

Fig. 39. Case 1. F. O'K. 95 degrees flexion, 12 years after arthroplasty.

bother at all and can do everything. Sometimes has to stop and think which is the knee operated upon." Has gained 40 to 50 pounds. The leg is straight. He has good power in quadriceps. Complete extension is possible and he has 95 degrees motion in flexion. He has absolutely no lateral mobility. (Figs. 37, 38, 39, 40, 41.)

The use of the muscle flap from the vastus internus in operations of the knee joint was suggested by Helferich (80, b). Cramer (40) followed his proposal, and in 1901 reported ten operations of ankylosis of the patella by interposition of a piece of the vastus internus. Six of these were successful. Hoffa (86) reports eight tibiofemoral cases of his own. He used fatty flaps. One case resulted in 15 degrees motion and ability to walk, the second in 15 degrees and painful motion, and the third in good motion, but with slight limping. In three cases ankylosis recurred. The seventh case had good walking ability and the eighth had 15 degrees motion 7 months after the operation. One patella case had 10 degrees motion 2 years after the operation. Hoffa believes his results are due to shortening and the contraction and atrophy of the extensor muscles. It is his opinion that the tendon should be lengthened by plastic operation or the tuberosity chiseled and attached higher up.

Murphy (120, a) first used his fascia method in 1901 on the knee joint. A large layer of fascia lata, with a thin layer of muscle attached, was dissected from the outer surface of the vastus externus, with its base below and anterior. A small flap of fascia covering the vastus internus was dissected free and

Fig. 40 (at left). Case 1. F. O'K. Anteroposterior roentgenogram 12 years after arthroplasty.

Fig. 41. Case 1. F. O'K. Lateral roentgenogram 12 years after arthroplasty.

Fig. 42. Line of Kocher's incision. The dotted line shows the prolongation of the incision which is necessary to obtain the flap for transplant. (Putti.)

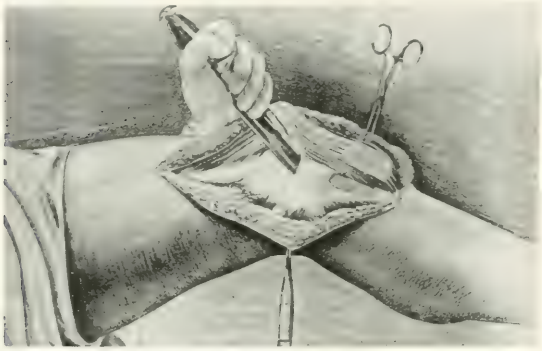


Fig. 43. Detachment of the tibial tubercle and the arthrolysis. (Putti.)

Fig. 44. Luxation of the joint surfaces. (Putti.)

placed between the patella and the femur. Between 1912 and 1916, Murphy reported fourteen operations. While at first he used fascia lata from vastus externus, he later used two implants of fat and fascia, one lifted from the inner and one from the outer aspect of the knee. He also changed his incision from two vertical cuts to a U-incision. The patella was treated in four different ways; by placing a flap under it, by turning it turtle, by rotating,

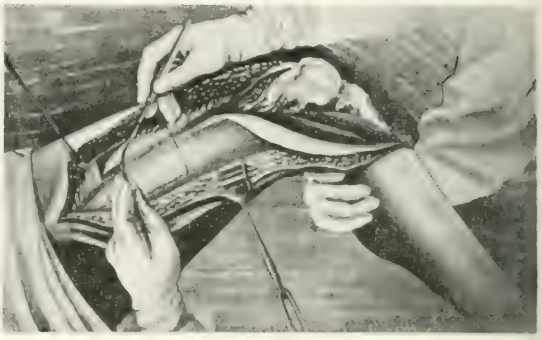


Fig. 45. Preparation of fascia lata flap. (Putti.)

Fig. 46. Attachment of the flap on the resectioned surfaces. (Putti.)

or by transplanting a detached flap of the trochanter. Of the fourteen cases, there were two splendid results, six good weight-bearing legs, one showed good flexion and extension improving, and three records are incomplete. In one, a sheet of paraffin was inserted beneath the patella.

Since 1901 many attempts to mobilize the knee, using Baer's membrane, Cargile membrane, free and pedunculated flaps of fascia, have been reported.

McCurdy (113) and Osgood (131) used Baer's membrane. The former did not report on his result, but Osgood found that, although

good or fair motion resulted, there was some lateral motion. These results, I feel, clearly show the loss of stability so dangerous to function, and do not represent arthroplastic, but rather flail joints.

Tubby (182, a) in 1914 interposed Cargile membrane in three cases with one good result. In the other cases the patients refused the after-treatment.

Schmerz (164) has had good results in the interposition of amnion membrane which he claims surpasses the fascia transplantation in simplicity and safety.

Whitacre (192), Neff (122), Owen (132), Quigley (147), Tubby (182, a), Pringle (143), McKenna (115), Thomson (180), Wheeler (191), Hohlbaum (88), Zeller (199), and Finochietto (64) have used pedunculated flaps of fascia. In general, good serviceable knees were secured; in two cases there occurred lateral motion and one case re-ankylosed. Of eighty-five cases on which Hohlbaum (88) reported, using free and pedunculated flaps, there were 78 per cent good results and 22 per cent poor.

Steindler (174), Thomson (180), Brandstrup (21), Hessert (85), and Goddu (71) reported the use of free fascia flaps with good results.

Whitacre (192), Appel (6), Ogilvy (127), and Hoerhammer (92) secured good motion by the interposition of fascia and fat flaps.

Fig. 47. Before mobilization. (Putti.)

Kirschner (100) and Osgood (131) followed Payr's method, using free fascia flaps, but in Kirschner's cases adhesions formed, and Osgood's result was only fair and necessitated the wearing of a splint. Simon (171) and Schloffer (163), however, secured good results by the same process. Tavernier (176) and Leriche (109) followed Putti's method. The former secured good motion, but Leriche's result was an unserviceable leg.

Flaps of tissue were tried by Hoke and Andrews (91) without success. Hofmann

Fig. 48. Fig. 49.

Fig. 48. After mobilization, showing weight bearing. (Putti.)

Fig. 49. After mobilization, showing active extension. (Putti.)

Fig. 50. Fig. 51.

Fig. 50. After mobilization, showing weight bearing. (Putti.)

Fig. 51. Eighty-five degrees flexion. (Putti.)

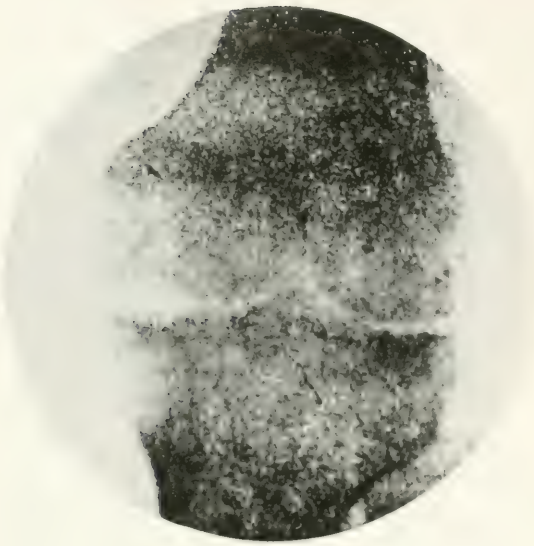


Fig. 52. Anteroposterior roentgenogram taken 27 months after intervention. (Putti.)

Fig. 53. Lateral roentgenogram taken 27 months after intervention. (Putti.)

(87, b), by the use of free periosteal flaps, obtained only an active motion of 15 degrees. Fascia lata and strips of subcutaneous tissue were used by Verral (187). Roeren (157) secured immediate good results with the interposition of flaps of fat, but the development of lateral motion made necessary the application of an apparatus. Cotton (39) secured a good result by the interposition of a muscle flap.

Campbell (26, a) based his report on twenty-four knee-joint cases. In ten cases using fascia flap, one resulted in 40 degrees motion, one in 30 degrees, six re-ankylosed, and on one there has not been time to report. He used Baer's membrane in nine cases; in one he obtained practically perfect motion; in one, 70 degrees of free motion; in four, the membrane extruded, and in two, of osteomyelitis, good results could not be expected. Two cases, in which free fascia from the thigh was inserted, were failures. In three operations in which prepatellar bursæ were inserted, one resulted in 15 degrees flexion and voluntary extension, the second in 20 degrees flexion and voluntary extension; it was too early to report on the third case. Of twenty of the cases on which there has been sufficient time to record the end-results, thirteen had definite voluntary motion, four did not obtain motion of sufficient value, and three were not successful, as dense bone was involved.

Campbell does not consider his work on the whole satisfactory. He recommends operations for ankylosis of complete destruction of the articular surfaces and adjoining bone, and solid union of bony surfaces. In cases of complete fibrous ankylosis, irregular scattered bands, or irregular fibrous union with areas of destruction, operation is also advised.

Up to 1917, Baer (9, b) had reported twenty-eight cases of arthroplasties on knee joints. He obtained serviceable motion only in cases of fibrous ankylosis between femur and patella or femur and tibia, of which there were seven cases; four gave 75 degrees, 40 degrees, 50 degrees, and 55 degrees of motion, respectively, and good function; three were failures—active tuberculosis set up. In five cases of bony ankylosis between patella and femur and fibrous ankylosis between tibiofemoral joint, excellent results were obtained. In sixteen cases of bony ankylosis between the patella and femur and femur and tibia, 19 per cent secured motion, 7 per cent had no ultimate motion, 6 per cent had 20 degrees, 2 per cent had 30 degrees, and 1 per cent, 45 degrees.

In his early cases Baer made two lateral incisions, one on each side of the patella,

chiseled the bones apart, and modeled the ends of joint surfaces. The first piece of membrane was carried through the opening on one side of the patella to the other side. The second piece overlapped the first; the joint was covered as far as the top of the subquadriceps bursa. Baer later used the horseshoe incision.

The writer believes that the general opinion is that lateral incisions do not give sufficient exposure to model the femur and tibia properly.

In 1920, Putti (145, f) reported on ten cases of knee arthroplasty. The largest range of motion obtained was 100 degrees, the smallest 50 degrees, and the average 82 degrees. The average age was 22 years. Putti thinks arthroplasty of the knee should be executed more frequently, and that the restoration of the knee joint can give the greatest satisfaction to the patient. There is more than an æsthetic value obtained by these operations.

Fig. 54 (at left). Ankylosis of the hip. Note flexion adduction, and inward rotation usually found in this condition untreated.

Fig. 55. Ankylosis of the hip. Note proper position, *i.e.* abduction 10 degrees—slight flexion (10 degrees) and slight external rotation.

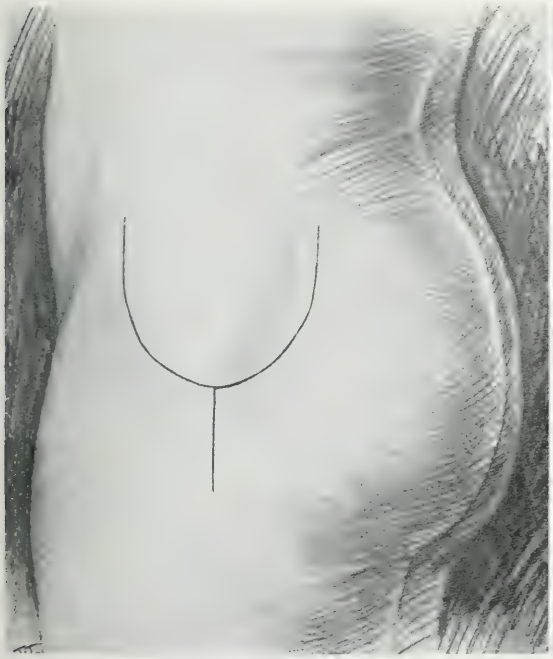


Fig. 56. "Goblet" incision through the skin and fascia lata down to the muscles and trochanter. The lower tip of the upper flap is placed just below the trochanter. The downward prolongation lies along the outer surface of the femur. (Murphy.)

Fig. 57. The flap of skin, fat, or fascia lata has been retracted upward; anterior and posterior borders of wound are retracted, exposing great trochanter with its attached muscles. The chain saw is passed on needle underneath superior muscle group, chiefly gluteus medius, down to capsule of joint, and trochanter with muscles attached is being sawed off in direction indicated by the dotted line. (Murphy.)

Fig. 58. The trochanter with its attached muscles is drawn upward, the anterior fibers of the gluteus medius muscle having been cut. The capsule of the joint is being incised at right angles to the direction of its fibers. In this operation it was not necessary to cut either the pyriformis or abdurator externus muscles. (Murphy.)

Fig. 59. The large gouge is being driven between the head of the femur and the acetabulum to divide the bony ankylosis between the two. A gouge has been selected the curve of which fits the normal curve of the head of the femur and the acetabulum, so that minimum amount of reshaping is necessary after division of ankylosis. (Murphy.)

Fig. 60. Reshaping and smoothing the head of the femur and the acetabular cavity with Murphy's end-mill and reamers. Head of the femur is dislocated backward from acetabulum preceding this step. (Murphy.)

Fig. 61. Preparation from under surface of the skin-flap of the Murphy pedicled fascia and fat flap for interposition between the freshened ends of the bones. The dotted lines indicate the extent of the flap. (Murphy.)

Fig. 62. The interposing pedicled flap of fascia and fat has been passed around the gluteus medius muscle posterior to its attachment, and dropped down over the acetabulum, to the rim of which it has been sutured with chromicized catgut. The head of the femur, when replaced, will lie on this flap. (Murphy.)

Fig. 63. The trochanter has been nailed back in place and the cut end of the muscles sutured. Usually Murphy used a continuous suture of phosphor bronze wire to reunite the muscles. The skin is sutured with horsehair and two or three sutures of silkworm-gut are inserted, if necessary. (Murphy.)

Putti uses the method set forth by Ollier of resecting the articulating surfaces, interposing membrane (Figs. 45 and 46), and preserving all the periarticular structures, particularly ligamentous. A modification of the Kocher incision is used; the cut is prolonged below to round the tibial tubercle (Fig. 42). This allows rolling in the skin after the insertion of the patellar tendon has been removed with the tibial tubercle. A piece of bone 4 by 3 centimeters and 1 centimeter deep is removed (Fig. 43). Solid union of this afterward is very important. As there is sometimes difficulty in making this union, this constitutes the weak point of Kocher's incision. Putti also uses the procedure of plastic elongation by an incision in a Z-form of the quadriceps tendon to overcome strong contraction of the extensor apparatus. This incision gives good access to joint surfaces.

The joint exposed (Fig. 44), the femur and tibia ends are shaped, the spine of the tibia made sharp, and the intercondyloid groove deepened. The transverse diameter of the condyles is preserved, but the sagittal diameter is decreased. In this way the loss of the crucial ligaments is compensated. The ankylosis is freed by a chisel to the posterior side. He uses manipulation to break up the bony lamellæ, smooths resected surfaces by files, and removes any cicatricial mass. He advises against using patella flaps, as he found the patella nearly always increases in thickness. The patella should never be completely removed. The ligamentum patellæ and tibial tubercle are nailed in place by a double-headed nail which is usually removed in a month. If necessary for flexion the quadriceps tendon is lengthened by the "Z" method.

For 15 days the whole leg is in a plaster gutter splint in semi-flexion; 4 to 5 kilograms traction is applied. After the removal of the stitches, the knee is suspended to an overhead frame with strap and pulley. The amount of exercise depends on the patient's strength, ability to stand pain, and the reaction of the

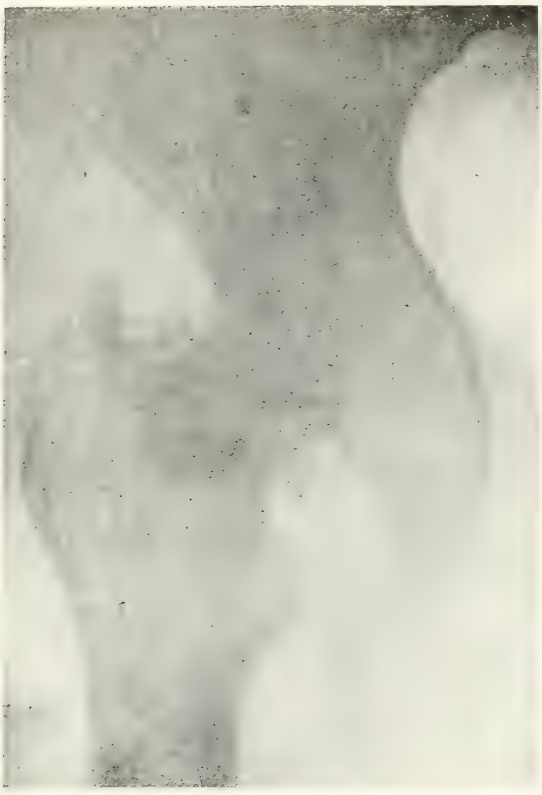


Fig. 64. Complete bony ankylosis of left hip with rotation of leg inward and abduction beyond pelvic inlet. (Murphy.)

joint. With the patient on the edge of the bed, the limb hangs out and flexion is obtained by gravity. In a month, massage, faradism, heat, and mechanotherapy (Bonnet's apparatus) are used. Auto-immobilization is essential. In 6 weeks a stiff leg brace is applied. The patient should have good use of the limb in 3 months.

Among his cases, Putti (145, d) reported one of complete bony ankylosis of the knee at an angle of 140 degrees. Suppurative arthritis had caused wounds to be open 5 months, and resulted in deep cicatrix. There was bony ankylosis between the femur and the tibia and between the femur and patella, and periarticular ossification (Fig. 47). Putti used his regular technique in operation, prolonging Kocher's incision at the base to encircle the tibial protuberance. One month after the operation there was 40 degrees motion, no pain, and complete extension. In 5 months the patient could walk long distances, had complete extension, and flexion to 110 degrees. There was slight lateral movement. In 7 months the flexion was 85 degrees and there was more lateral movement. The leg was serviceable. Fourteen months after the operation the patient returned to the hospital because of severe pain in the knee. The joint was flexed in the position of semiflexion and could not be extended. After traction and hot air applications, the joint improved. The patient walked again, and 27 months after the first intervention he could flex his knee to an angle of 85 degrees, had a movable patella, and *no* lateral mobility (Figs. 49, 50, 51, 52, and 53).

HIP

Ankylosis of the hip practically always is seen in the position of deformity; that is, flexion and adduction (Fig. 54). The correction of this deformity results in a functional limb for working use (Fig. 55). It has, however, a distinct disadvantage in sitting, stooping, going up and down stairs, etc., as well as somewhat interfering with the gait. As the joint is rotary, it lends itself to arthroplastic measures. In single ankylosis, interference is decided upon with caution and judgment. In double ankylosis, the decision is easier.

Any increase in motion in this joint improves the knee-joint action, and this, together with the hypermobility of the lumbar spine, distinctly increases function. One must, however, remember that stability is very necessary, and unfortunate results, such as dislocation, have followed arthroplasty of the hip where stability has not been obtained.

Hoffa's (86) statistics in 1906 recorded three operations on the hip by Rochet and two by Nélaton, using muscle interposition. One of the five cases showed a mobility of 40 degrees in 1 year, the other a good function of 45 degrees in 8 months. One case had good mobility at first, but it diminished later. The fourth case had good motion 5 years after the operation, and the fifth case resulted in poor function 9 months after intervention.

Hoffa (86) reported one of his own cases in which he used a flap of fatty tissue. Seven-

Figs. 65, 66, and 67. One year after operation, showing that patient has a full normal range of motion. (Murphy.)

teen months after the operation the patient walked, but active mobility was somewhat restricted.

Stein (173), in 1907, in Bier's clinic, interposed a flap of the sartorius muscle in a case of double ankylosis of the hip. In 5 months there was 30 per cent of normal flexion, and extension and abduction of 10 per cent of normal.

Ahrens (1), in 1908, used the gluteus maximus muscle. The patient walked in eleven weeks.

Meyer (117), in 1909, cited a case of using a flap of fatty tissue with a thin layer of muscle on a hip ankylosed from spondylitis. The thigh was flexed on the pelvis at 150 degrees. After the operation the patient had passive motion to 60 degrees, extension to normal, adduction 30 degrees, and abduction 45 degrees.

Durán (57), in 1910, used membrane, and he was able to obtain motion of 50 per cent of normal.

Murphy (120, b) found that the hip joint gave him the best results in arthroplasty. He used three incisions; the original one was U-shaped, beginning 1.5 inches above the trochanter and 1 inch behind it, extending down 2 inches below and passing under and in front of it up to a point opposite the commencement. Sometimes the skin was divided down at the lowest point of the U to form the large interposed flap. The second incision was along the iliotrochanter line 1 inch below and in front of the trochanter and upward for about 5 inches in a straight line with the anterior superior spine of the ilium. The third was a modification of the second, in that the incision was curved and convexed backward behind the trochanter (Fig. 56).

His next step was to free the trochanter by a chain saw and retract it upward with attached muscles (Figs. 57 and 58).

The ankylosed head of the femur was severed from the ilium, as near the anatomical line as possible, with a carpenter's and cabinet curved chisel (Fig. 59). It was drawn obliquely into the acetabular cavity for 1 inch. The head was fractured out and a special globular burr fashioned the acetabular cavity. A cup-shaped well conformed the femoral head (Fig. 60).

A flap of fat and fascia, fascia lata, and subcutaneous fatty tissue (one-fourth inch thick) was inserted behind the head and neck of the femur, and the edge was sutured to the acetabular margin and to the capsular ligament with phosphor bronze wire (Figs. 61 and 62). The head was replaced. The trochanter was nailed in place (Fig. 63). The fascia was re-approximated by chromic catgut and the skin sutured with silkworm or horsehair. No drainage was used.

The field operated upon was dusted with bismuth subiodide powder and the wound sealed with gauze saturated with collodion. A pad of plain sterile gauze, moistened with 95 per cent alcohol and 61 per cent phenol, was placed over the hip 4 or 5 inches beyond the line of incision on either side. A Rainey

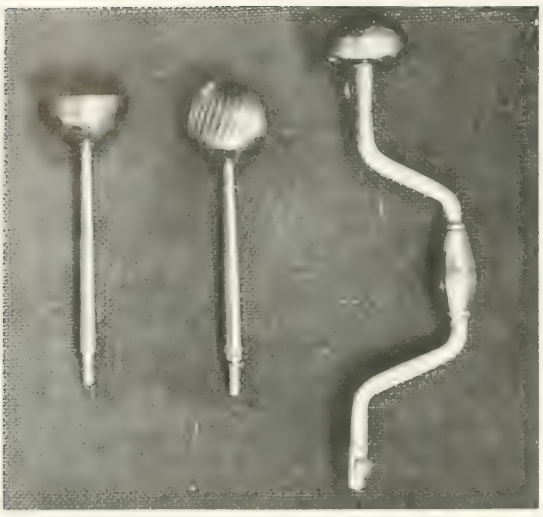


Fig. 68. Murphy instruments.

travois splint and Buck's extension with 20 to 25 pounds were applied. Both legs were dressed in an abducted position.

Passive motion was instituted in 3 or 4 weeks.

In the majority of cases of ankylosis of the hip reported by Murphy, there resulted a good range of motion and ability to walk without support. Among them was one case of metastatic origin, of complete bony ankylosis of the left hip with rotation of the leg inward and adduction beyond the pelvic inlet (Fig. 64). The usual technique was followed in the operation. The patient made an excellent recovery. In 1 year she could walk without support and had full flexion (Figs. 65, 66, 67).

Pettis (138), Torrey (181), Clark (36), Gibby, reported by McCurdy (113), Ceballos (30), Prando (142), Thomson (180), and Burlew (25) reported cases in which they had followed the technique of Murphy, using pedunculated flaps. Several good results were recorded. Thomson believes his case re-ankylosed because he removed too little bone.

McKenna (115) outlined his technique as a modification of the Murphy goblet-shaped incision. The cut was carried farther back to secure a fat and fascia flap that comes directly under the gluteus muscle. This fits into the acetabular cavity without cutting the pedicle of the flap.

Perthes (136), in 1919, mobilized a hip joint ankylosed in the position of adduction. After the freeing of the ankylosis two pedunculated fat and fascia flaps were interposed. In spite of ankylosis of the other hip joint and of the two knees and of paralysis of the sciatic nerve, walking was possible.

Baer (9,b), in 1917, reported his series of fifty cases of bony ankylosis of the hip in which an arthroplasty was done with the use of the chromicized pig's bladder. The resulting motion in nine cases of gonorrhœal arthritis was active motion in 89 per cent. Two cases operated on in 1909 resulted in 20 degrees and 40 degrees motion, respectively. Infection was the cause of failure in one case; in the other, the periarticular tissues needed stretching. In twenty-one cases of tubercular origin, 66 per cent good voluntary motion, utility and good walking ability were secured. One hundred per cent good serviceable motion resulted in fifteen cases of infectious arthritis. In five cases of arthritis deformans involving spine, hip, knees, and ankles, 60 per cent motion was obtained.

Baer makes his incision from the anterior superior spine, down the thigh, parallel to the femur, between the tensor femoris muscle on the outer side and the sartorius on the inner. The capsule is stripped back, the ends of the bones shaped, and the membrane thrown around the femoral head.

Baldwin (10), in 1915, reported a successful result, using Baer's membrane.

Neff (122) used a U-incision with reflexion of the flap upward for the formation of a long, broad flap of fascia lata. If enough capsule was available, it was used for flaps; if not, fascia was interposed.

In 1913, Osgood (131) reported on five cases; in one, using the capsule for a flap, the result was poor; in the second case, using tissue flap, the outcome was fair; in the third case of excision, death resulted; in the fourth case of fibrous ankylosis, in which free fascia was used, the result was good; and in the fifth case of fibrous type, doing a part excision according to Baer's method, the result was fair and improving.

Two methods are used by Payr (134, b) on the hip. One consists of the separating of the

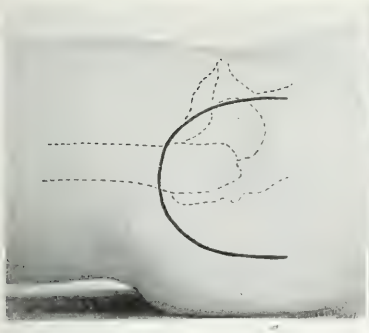


Fig. 69. U-shaped skin incision as used by author.

Fig. 70. Line of fascia incision preparatory to removal of great trochanter.

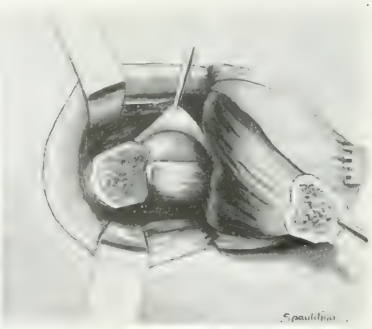


Fig. 71. Incision through capsule parallel to and in center of femoral neck.

Fig. 72. Separation of the femur from the acetabulum.

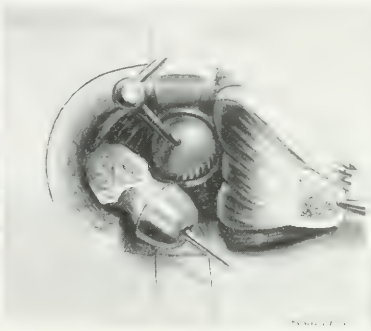


Fig. 73. Reaming out of acetabulum and rounding of head with Murphy male and female rasps.

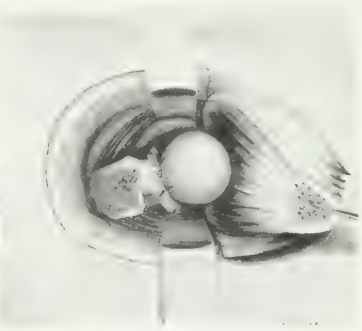


Fig. 74. The fascia flap sewed around neck of femur with interrupted sutures and tied with a purse string.

ankylosis, smoothing off of the head of the bone or building a new rounded epiphysis out of the neck of the femur, with interposition of fat (free or pedunculated) or a flap from the tractus iliotibialis. The second process is the formation of a pseudoarthrosis as near as possible to the acetabular margin, likewise with the interposition of soft parts. Payr tries to form the pseudoarthrosis after the manner of a saddle joint, simulating the carpometacarpal joint.

Corner (38), Steindler (174), and Hallopeau (76) reported the use of fascia lata in the hip. Corner and Steindler did not record their results, but Hallopeau secured a good weight-bearing leg after operation for double bony ankylosis of 4 years' standing.

Grange (74), in 1920, reported three cases of arthroplasty. In one, of bony ankylosis with internal rotation of the thigh, of traumatic origin, a curved incision was made between the crest of the ilium and the great

Fig. 75. Reduction of femoral head.

trochanter, the femur was divided at the neck and a flap of gluteus medius sutured over the raw end of the neck of the femur and a loose flap of fat from the buttock placed in the cup in the head of the femur. Within 2 months the patient could flex his hip to a right angle.

Hohlbaum (88), in 1921, reported twenty cases of hip ankylosis of tubercular, rheumatic,

Fig. 76.

Fig. 77.

Fig. 76. Case 1. O. P. Roentgenogram of right hip before arthroplasty. March, 1916.

Fig. 77. Case 2. O. P. Roentgenogram of left hip before arthroplasty. March, 1916.

Fig. 78.

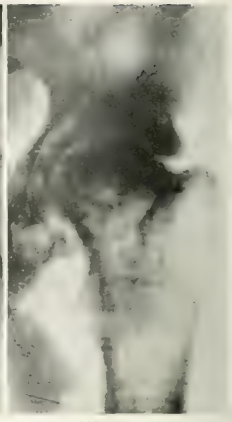


Fig. 79.

Fig. 78. Case 1. O. P. Roentgenogram of right hip 2 years after arthroplasty.

Fig. 79. Case 2. O. P. Roentgenogram of left hip 1½ years after anthroplasty.

gonorrhœal, arthritic, and other origins. Free fascia and pedunculated flaps were interposed. In his series there were six very good results; five good results; six cases re-ankylosed; two patients died; and in one the result was unknown.

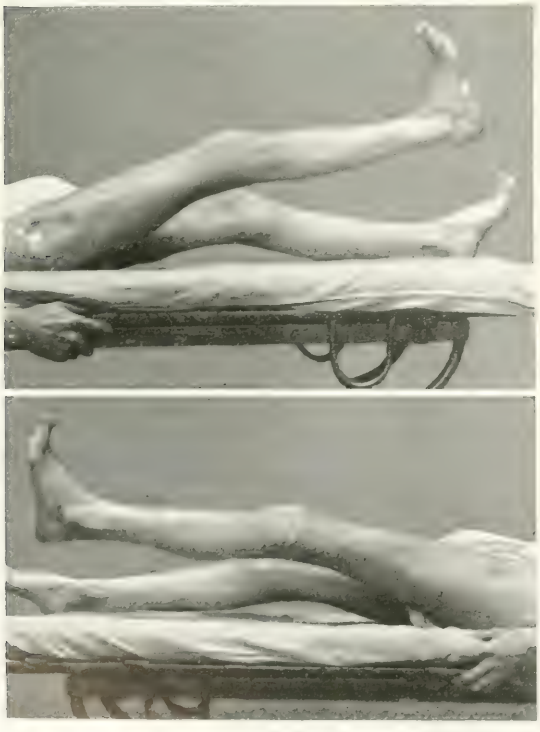


Fig. 80 (above). Case 1. O. P. Motion in right hip 1½ years after arthroplasty.

Fig. 81. Case 2. O. P. Motion in left hip 1½ years after arthroplasty.

Author's technique. In operation on the hip I use the following technique:

The patient is given a very careful two-day preparation of the hip from the rib-line to below the knee.

A skin incision is made beginning at the anterior superior spine and running in a horizontal plane to about 2 inches below the level of the trochanter, at which point it curves over the femur, 3 to 4 inches below the trochanter in a U-shaped fashion (Fig. 69). This flap, with considerable fatty issue attached, is elevated, raised to its base line, and retracted.

A similar incision is made through the fascia external to the sartorius and sweeps around about 3 inches below the trochanter, at which point it reaches the base of the femur (Fig. 70). The periosteum is separated downward one-half inch and then upward to the base of the trochanter.

With a two-inch osteotome the entire trochanter is removed and elevated, taking with it all the muscle attachments.

An incision is then made through the capsule beginning on the ilium and passing parallel to, and in the center of, the femoral neck to the base of the detached trochanter (Fig. 71). At the attachment of the capsule

Fig. 82. Fig. 83. Fig. 84. Fig. 85. Fig. 86.

Fig. 82. Case 1. O. P. Motion in right hip 1½ years after arthroplasty.

Figs. 83 and 84. Cases 1 and 2. O. P. Lateral view, standing after arthroplasty.

Fig. 85. Cases 1 and 2. O. P. Anteroposterior view, standing, after arthroplasty.

Fig. 86. Case 2. O. P. Motion in left hip 1½ years after anthroplasty. (Patient has about twice this motion but is handicapped in further flexion by double ankylosis of the knee.

to the femoral neck, it is cut off around on both sides for a distance of 1.5 inches and retracted. A blunt dissector then frees the capsule from the neck as much as it is possible to free it.

A study of the junction between the head and the ilium is made, and then with a curved chisel, covering a small space at a time, the femur is separated from the acetabulum. Care should be taken to follow the outline of the acetabulum, as this is always hard, while the head is usually atrophied (Fig. 72).

Finally the head is freed and dislocated. With the Murphy male and female rasp (Fig. 68), the acetabulum is thoroughly reamed out and the head is thoroughly rounded (Fig. 73). Great care should be taken to remove all spicules of bone.

A piece of free fascia lata from the outer side of the opposite leg is removed and sewed around the neck of the femur by interrupted sutures. Then a purse-string suture is tied about it tightly (Fig. 74).

The head is reduced (Fig. 75). The old capsule is returned and sewed together and to the old attachments as nearly as possible. I feel that this very materially adds to stability and ensures against dislocation or a wabbly, unstable joint.

The trochanter is then pulled down to its old position and held by resuture of the periosteum with fascia originally elevated. The skin is closed and the leg placed in plaster-of-Paris cast from the nipple line to the toe, with the leg in 10 degrees abduction, complete extension, and with a little pressure over the trochanter.

The cast remains on 2½ weeks and is then removed and traction applied. Passive motions are started at the third week and should always be within the limits of pain. The patient is encouraged voluntarily to contract the thigh muscles and thereby get voluntary control early.

The patient may walk with crutches in 6 weeks and bear a little weight in about 8

weeks. Convalescence as regards motion varies with the type of individual, but all motion should be within the pain limits.

Case 1. O. P., age 24. Patient had an ankylosis of 3 years' duration involving both hips and knees, due to an infectious process, probably neisserian in origin. (Figs. 76 and 77.)

April 12, 1920. Arthroplasty of right hip by Dr. Andrew R. MacAusland, using the technique as outlined. It was then about 3 years since the original infection. The operation was followed by some shock. The wound healed perfectly. A cast was applied.

May 17, 1920. The cast was removed and passive movements encouraged.

June 5, 1920. Patient out of bed with crutches.

June 10, 1920. He walked with crutches.

June 12, 1920. Discharged from hospital.

January 13, 1923. No pain. Motion in flexion 40 degrees. Motion in adduction and abduction in arc of 15 degrees to 20 degrees. (Figs. 78, 80, 82, 83, 84, and 85.)

Case 2. O. P., age 24. The previous history of this case was reported under Case 1. Both hips were ankylosed. (Figs. 76 and 77.)

November 2, 1920. Seven months after the operation on the right hip, Dr. Andrew R. MacAusland did an arthroplasty of the left hip, using the regular technique.

November 29, 1920. The cast was removed. The wound healed by first intention.

December 6, 1920. Passive motions were started.

December 17, 1920. Patient was up in wheelchair. He had some sensitiveness. Motion was omitted for 1 week.

December 26, 1920. Passive motion renewed.

January 4, 1921. He walked with crutches.

January 22, 1921. He was discharged from hospital.

January 12, 1923. No pain. Motion in flexion 40 degrees. Good abduction and adduction. Excellent functional result. (Figs. 79, 86, 81, 83, 84 and 85.)

JAW

Ankylosis or greatly limited motion in the temporomaxillary articulations early assumes dangerous proportions, because of the inability of the patient to take nourishment. In young children this condition is complicated by the dangers from swelling during throat infections, so common in this type of case. Much of this infection undoubtedly arises from the inability to give proper hygienic care to the mouth and teeth. Arthroplasty is indicated in all of these cases, and, although the mortality is high in young children and the dangers of infection considerable, the relief is at times a matter of necessity. The method as described by Murphy has been accepted as standard.

An incision is made in front of the ear from one-half inch below the root of the zygoma up to the hair line. The incision may be curved in, convexed backward, passing forward under the zygoma to 1 inch in front of the ear, 2 inches above the zygoma. The L-incision gives the best access (Fig. 87).

The ankylosis is divided and a flap of temporomaxillary muscle aponeurosis dropped over the zygoma. (Figs. 88, 89, 90, 91, and 92.)

Murphy (120, b), in 1913, brought to our attention his series of nine arthroplasties of the jaw, seven for bony ankylosis and two for extra-articular fibrous fixation. The first case, of a boy with fibrous ankylosis of the left temporomandibular joint and bony ankylosis of the right, resulted in the ability to open his mouth 1 inch, 4 weeks after the operation. Now he can put an apple between his teeth. An operation on a case of fibrous ankylosis allowed the opening of the jaws to 1.5 inches 3 months after the operation.

Another patient who had fibrous ankylosis could open his mouth 1 inch in 5 weeks after the operation.

As the impairment of health is involved in an ankylosed jaw, early attempts at operation were made.

Hoffa (86) collected eighteen cases: Helferich one, Lentz one, Mikulicz one, Henle one, Bilczynski one, Kusnetsoff one, Gluck two, Rochet four, Schmidt one, Foederl one, Orlow two, Meyer one, and Beresowski one. In thirteen cases in which muscle flaps were used, good results were secured, and the average separation of the incisor teeth in ten cases was 2.6 centimeters. Good results were obtained in two cases using skin flaps. In one, inserting hog's bladder, the incisors were separated 2.6 centimeters, and in two cases, using gilded plates, 2 and 1.75 centimeters.

Hoffa (86) reported two of his own cases; one of simple resection resulted in a separation of 2 centimeters and the other, using a temporal muscle flap, allowed the placing of two fingers between the jaws.

Biermann (16), in 1909, reported using a flap of the temporal muscle and obtaining a good result.

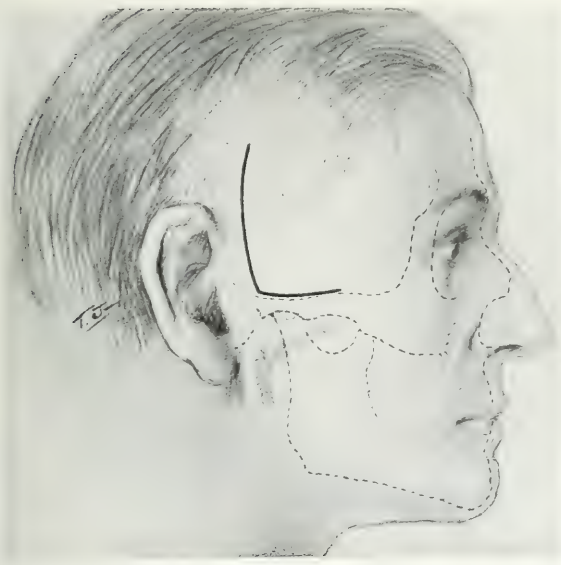


Fig. 87 (at left). L-shaped skin incision above the zygoma and in front of the ear, so placed to avoid injury to the facial nerve. (Murphy.)

Fig. 88. Skin flap retracted and zygoma and neck of mandible exposed. Two curved periosteal elevators are shown closely applied to the posterior surface of the neck of the mandible, thus protecting the internal maxillary artery from injury during division of the bone. (Murphy.)

Stein (173), in the same year, obtained a perfect recovery of a case using muscle flaps.

Baer (9, b), in 1917, recorded his series of nine cases in which eleven operations on temporomaxillary jaws had been done. One excellent result was secured in which a boy had even more motion than normal. The other cases showed good results. In Case 8, the patient could open his mouth only 3 centimeters; this case had been operated on twice by other methods and had been ankylosed 23 years.

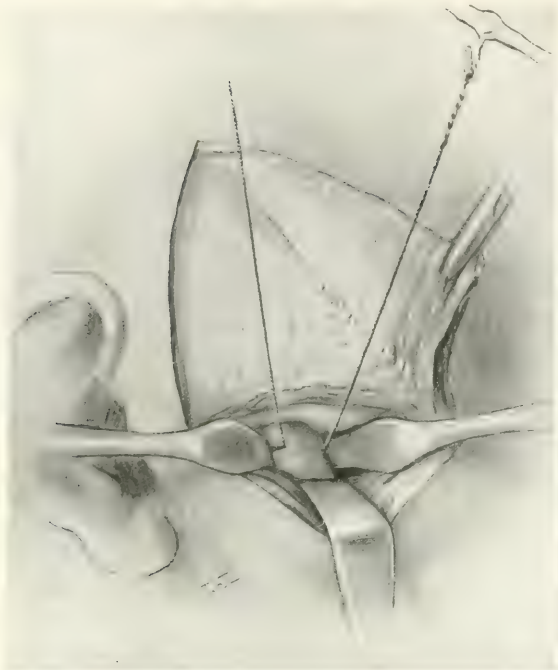
An arthroplasty on another case of marked cicatricial changes allowed the opening of the mouth to the extent of 0.5 centimeter. A baby, 18 months old and in weakened condition, died from the effects of the operation.

Baer, in his technique, first scrubs the place of operation, using potassium permanganate, oxide, and bichloride of mercury, ether, and alcohol. The incision is made parallel to the zygoma and along its lowest border; the fibers of the external pterygoid muscle are separated and the temporal muscle retracted forward. He then cuts through the periosteum of the ramus of the inferior maxillary bone and exposes the condyle. This is separated from the ramus and the temporal bone. The bones are shaped and a cuff of membrane sewed to the periosteum of the bone. The muscle is brought together and sewed, and the wound is closed. After 2 weeks the patient is encouraged to use his mouth, and movements are regulated by graduated corks.

An arthroplasty, using Baer's membrane, was reported by Osgood (131), in 1911, for complete bony ankylosis of the jaws of 2 years' duration. A slight pus discharge made necessary an incision and the removal of the membrane. Four months after the intervention the motion was good.

Neff (122) used a curved incision beginning in front of the tragus and carried up over the zygoma. Fascia was stripped from the zygoma subperiosteally. The condyle was separated from the glenoid fossa and the joint mobilized. A flap from the temporal fascia or masseter was sutured to the capsule on the inside.

Putti (145, a), in 1913, reported three jaw arthroplasties. In operation, he used Abbe's incision, resected enough bone to allow opening the jaw and interposed a free flap of fascia lata 6 by 8 centimeters, taken from the base of the great trochanter. In the post-



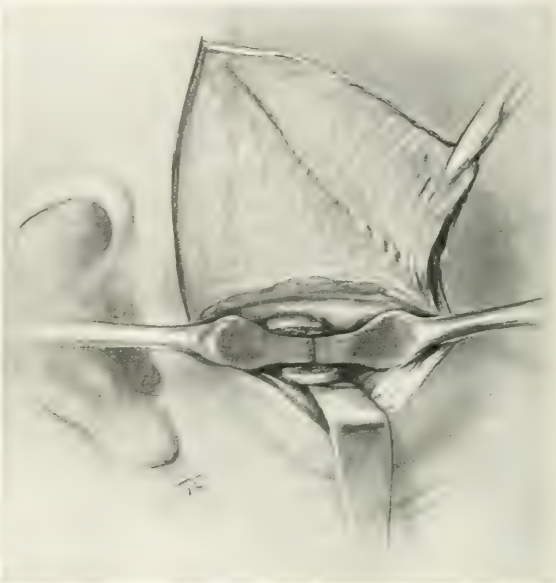


Fig. 89. Dividing the neck of the mandible with the Gigli saw. In actual operation the saw is not allowed to make so acute an angle as shown in the illustration, because of its great tendency to break when sharply bent. (Murphy.)

Fig. 90. The neck of the mandible has been divided, the cut ends of the bone separated by traction on the lower fragment and space thus provided for the interposing fascia and fat flap. The curved periosteal elevators still protect the internal maxillary artery from trauma. (Murphy.)

operative treatment, the passive exercises are regulated by means of wooden wedges.

Four months after intervention in the first case of total bilateral ankylosis of blennorrhœal origin, the patient had nearly normal motion. The after-treatment had been neglected, which accounted for lack of complete mobility. In 1 month after operation in the second case of complete congenital ankylosis of the right temporal jaw, the child could open his mouth to allow a space of 2.5 centimeters between the incisors. The third case, one of complete ankylosis between the condyle and glenoid on the left side, showed in 1 year the ability to open the mouth fully.

Blair (18), in 1914, found a flap of subcutaneous temporal fascia admirably adapted for interposition. His incision was almost completely within the hair line. Enough bone was removed to leave a space 0.5 inch wide. The immediate result was 0.75 to 1 inch opening, and this, by the use of a rubber bottle-stopper, was increased further.

Carr (28), in 1917, obtained three good results, using a modification of the Murphy method. He was unacquainted with the Murphy process at the time, but he would use it on future cases. In 18 months one patient, who had had complete fixation for years, could separate his teeth 1.25 inches. The second patient, in 3 weeks, could open and close his mouth without discomfort, and the third patient could eat in 3 days, as the muscles had not been greatly contracted.

The same year Prando (142) applied the Murphy method in a case. Although it became gangrenous, the case turned out well and the patient can open his mouth and talk clearly.

Henderson and New (81), in 1918, tabulated twenty-three cases of ankylosis of the lower jaw operated on in the Mayo Clinic during a period of 8 years. They divided the ankylosis into articular, extra-articular, and articular-extra-articular types, depending on the location of the fixation. Fifteen cases were articu-

Fig. 91. The pedicled fascia and fat flap is dissected from temporal fascia and free end of flap is turned inward between divided ends of mandible and sutured securely in place with tacking stitches. (Murphy.)

Fig. 92. The flap is now in place and the wound ready for closure. (Murphy.)

lar, five extra-articular, and the remainder articular-extra-articular. The average age of the patients was under 10 years. Excision was the basic principle of each operation, and no interposing substance was used.

The fifteen cases did well, and from 1 inch to 1.75 inches separation was obtained. In the extra-articular types the best results were secured by forcible stretching. In the articular-extra-articular type the scarring of the muscles prevented wide separation, but all the patients secured an opening of an inch.

Douglas (54), in 1919, operated for complete bony ankylosis of the left temporomaxillary joint. A horizontal incision was made just above the zygoma, the bones were separated and a flap of the temporal fascia with overlying fat interposed. The final result was excellent, although after-treatment was not carried out.

Woolsey (198) also did a similar operation and obtained a good result. He kept the jaws apart for some time after the operation.

Kerr (99), in 1920, cited four successful cases. One patient could open his mouth one-sixth inch and the second one-fourth inch. A curved, L-shaped incision was made, beginning 2 inches above and 0.5 inch in front of the ear and down to the external auditory opening, then anteriorly for 1.5 inches. The facial nerve was avoided. The condyle of the mandible was sawed off with a chain saw and a flap of temporal muscle inserted. Both patients can masticate normally. The third patient, suffering from fibrous and bony ankylosis of both joints of the mandible, with contractions of the periarticular muscles and fascia, after operation could masticate solid food. He had to guard against muscle contractions. Fourth patient after operation could open her mouth normally and masticate food.

Ritchie (152), in 1920, emphasized the importance of the after-treatment in the form of continual motion during waking hours, and wearing a rubber gag at night. He reported two cases using flaps of temporal muscle. In one case the flap was cut too short and pulled off when applied as a free flap. It was ex-

truded on the fifth day. In the other case the flap was cut large enough. The end-results of both cases were equally complete.

Chubb (34), in 1920, reported a method which he had found very successful. He divided the operation for ankylosis of the jaw into two groups according as the bone is resected from the region of the condyle or rom the horizontal ramus.

The bony or fibrous ankylosis in the five cases he described was between the anterior border of the coronoid and the pterygoid aspect of the maxilla. Four cases were traumatic. One was infective in origin, and followed a bilateral suppurative arthritis of the temporomandibular joints in infancy.

In operation, the incision started in the preauricular fold at the lower level of the external auditory meatus, passing vertically upward to the level of the tip of the pinna, and curving forward below the superior temporal crest to terminate anteriorly within the hair region. The zygoma was exposed and the necessary bone removed piecemeal. The whole coronoid process was removed.

In the case of infective origin of 15 years' standing, the condylar neck region and coronoid of the left and right sides were resected. The operation was completed by a flap of temporal fascia and muscle.

The result in all cases was a gap of at least 2.5 centimeters and a very satisfactory power of mastication.

Imbert (95), in 1921, emphasized regulating the dimensions of the incisions for ankylosis of the jaw by the crossing of the facial nerve on the neck of the condyle. The upper extremity of the incision should be about 2 centimeters above the most prominent part of the tragus. The resection of the condyle is made by means of scissors and is at least 0.5 centimeter in height. He recommended the interposition of soft parts.

Dufourmentel and Darcissa (55), in 1921, presented two cases. In one, of complete temporomaxillary ankylosis of gonococcic origin, the thickness of bone was destroyed and a piece of rubber inserted. Their special apparatus was used in the after-treatment. Three months after the operation, the power and amplitude of the jaw was normal. A second case, using a muscular aponeurotic flap, failed; resection, with no interposition of rubber, resulted in a normal joint.

Bockenheimer (19), in 1922, used an incision behind the ear in freeing bony ankylosis of the jaw, of inflammatory origin. After resection, a flap of fat and fascia was interposed. In 15 months the patient could open her mouth normally. This incision had the advantage of avoiding the facial nerve and of hiding the scars.

Gilpatrick (69) recently (1922) reported a severe case of ankylosis of the jaw very similar to a case reported by Murphy. The patient had had almost complete ankylosis of the inferior maxilla for 14 years as a result of scarlet fever, complicated by an infection of both mastoids. The food had to be macerated in the plate and the boy could talk only through clenched teeth.

The right side was attacked first in operation. An incision 1.5 inches long was made in front of the right ear from a point 0.5 inch below the zygoma upward. All new bone was removed. The jaw could then be opened so that the left side was not touched. A flap of fat and fascia from the skin anterior to the original incision was interposed. In 10 days the patient could eat.

SHOULDER

The shoulder joint is rarely the seat of troublesome ankylosis. The mobility of the scapula replaces the lost motion, especially when ankylosis has occurred in the position of election; that is, abduction of 50 degrees to 70 degrees and flexion of about 15 degrees to 20 degrees forward of the frontal plane, in which position the shoulder function closely simulates normal. (Figs. 93 and 94.)

No arthroplastic measure can be considered in the absence of the deltoid muscle.

The first arthroplasty of the shoulder was reported by Nélaton (123), in 1903. The operation was done by Caville. A four-inch incision was made below the clavicle, passing externally to the coracoid process, down along the arm following the fibers of the deltoid. The head of the humerus was divided at the level of the anatomical neck. A piece of deltoid obtained by a transverse section was interposed between the surface of the humerus and

Fig. 93 (at left). Ankylosis of shoulder. Position of rest; note rotation of scapula with full rest position of arm.
Fig. 94. Ankylosis of shoulder. Full abduction obtained by rotation of scapula.

the glenoid cavity. A counter-incision was made at the same level and a thread passed through the opening, surrounding in loop form the extremity of the muscular strip. By tightening, the muscle was applied in the articular cavity. The result was good; there was passive motion in 3 days. The patient can sew. Abduction is limited.

Hofmann (87, b), in 1908, used periosteal transplants from the tibia. The results were excellent; 1 year after the operation the rotary movements were almost normal. There was active abduction with fixed scapula up to 45 degrees, after which the scapula moved with the arm.

Ochsner (125), always conservative in advising arthroplasties in ankylosis with deformity, makes a vertical incision over the middle of the deltoid muscle, and separates the fibers by the Kocher dissector. A vertical incision is made in the capsule to expose the head of the humerus. This is severed by cutting the neck with a chain saw. Strands of silkworm gut are inserted for drainage. The arm is bandaged snugly to the side and the forearm placed in a sling. He has not found it necessary to use a fascial flap. All of his patients, within a few months, have been able to use the arm as before ankylosis; they can comb their hair, etc.

In the treatment of ankylosis without deformity, in the finger, ankle, shoulder joint, or wrist, Ochsner does not consider arthroplasty indicated. In the knee, elbow, and hip, the subject is debatable. On the knee, he uses the resection method; on the hip, subtrochanteric osteotomy; and on the elbow, force only. He commends the Murphy method.

Neff (122) believed that operation in the shoulder is rarely indicated, as the scapular muscles provide good function. In case of intervention he advised reaching the joint through an incision 3.5 inches long, extending from the base of the coracoid and on a level with it, down on a line with the bicipital groove. The cephalic vein serves as a guide. The greater tuberosity is divided by means of a Gigli saw and retracted upward. The remainder of the operation is like that on the hip. Fascia or capsule may be used as flaps.

Murphy (120, e) did not report an arthroplasty of the shoulder, but in 1913 he outlined his technique on the cadaver as follows: The skin and deltoid are split and the fascia separated along the anterior margin for 4 inches. It is then elevated to expose the coracoid process with the head of the biceps and coracobrachialis. The process is divided three-fourths inch from the tip and displaced outward. The ankylosis is chiseled between the glenoid fossa and the head of the humerus, and an additional excavation of the glenoid fossa made. An incision at a right angle to the original incision is made across the chest, over the middle pectoralis major muscle. A flap of fat, aponeurosis, and pedunculated muscle is placed between the head of the humerus and the glenoid fossa. The anterior portion of the deltoid may also be used as a flap.

W. L. and C. P. Brown (23), in 1914, reported the use of a portion of the short head of the biceps for the interposed flap. It is located correctly anatomically and covered with a tendinous sheath; its attachment to the coracoid process gives the pedicle the right

Fig. 95 (at left). Ankylosis of wrist. Position of weakness (flexion); note compensatory contraction of phalanges.
Fig. 96. Ankylosis of wrist. In position of strength, a most important factor in all wrist cases.

location. An incision in the shape of a reversed "S" is made from the junction of the middle and outer thirds of the clavicle, forward and downward below the acromion process. The muscle fibers of the sulcus should be separated, coming down directly on the tendinous attachment of the inner head of the biceps. The tendon of the pectoralis major should be transfixed with a linen thread and then cut loose from the humerus; the attachment of the inner fibers of the deltoid is transfixed and severed from the humerus, which will facilitate its retraction. The forefinger of the left hand is passed beneath the inner head of the biceps, separating it from the coracobrachialis and then its sheath and fibers cut across 4.5 inches below its attachment at the glenoid cavity. About one-half the muscle, of fan-shape, 4.5 by 3.5 inches, is taken. The capsule of the joint is opened and the head of the humerus is separated from the glenoid fossa, preserving the head of the biceps if possible. Enough capsule is removed to mobilize the joint. The flap is drawn in place by three No. 1 chromicized catgut sutures, guided by the finger. If the capsule allows good motion, it should be sutured; otherwise, it should be free. If the pectoralis major has contracted, it should not be re-attached to the humerus unless it is lengthened.

The arm is put in a cast at right angles to the body with the forearm flexed, if the head of the biceps is severed. The cast is removed in 10 days.

The case of infectious origin on which the operation was done resulted in perfect motion. The patient, a carpenter, resumed his trade in 6 weeks. There was some restriction of the arc of motion because of periarticular contraction, but 2 years after intervention the patient had practically recovered the arc of motion.

Ringel (151) demonstrated a case, in which there had been a complete shattering of the shoulder region, treated by freeing of the joint and interposing a pedunculated muscle flap from the deltoid. The immediate result was so good that the patient returned to the army. Later it was found that the flap had sloughed and new bone formed. In the second operation, a broad fat and fascia flap from the thigh was fixed over the humerus. Free motion in all directions was obtained; the arc of motion was limited because of the great atrophy of the deltoid.

Thomson (180) reported a case in 1917. He made an anterior incision, removed the greater part of the head of the humerus and stitched in a piece of fascia lata from the thigh. The limb was put in the position of right angle abduction. A sufficient range of movement was secured.

Verrall (187) believes he was justified in operating on a shoulder adducted and having a small degree of painful motion, as he did not jeopardize arthrodesis in a good position. He exposed the joint along the anterior border of the deltoid and dislocated the humerus

through the wound. The glenoid was hollowed into shape and three-fourths of the humerus removed. A flap of subcutaneous tissue from over the deltoid was turned over the glenoid. He does not report his result.

Grange (74), in 1920, did an arthroplasty for ankylosis of the shoulder joint in a slightly abducted position with a good deal of destruction of the head and great tuberosity. In the operation, an incision was made along the lower border of the clavicle and down the front of the arm for 3 inches; another was made just below the acromion process to meet the first, and a third was made along the lower border of the pectoralis major. This was divided where it crosses the axilla, and the anterior half of the deltoid was cut through 0.5 inch below the acromion process, and turned down. The short head of the biceps and coracobrachialis were then divided. The humerus was exposed and rounded, and a large flap of superficial fascia turned in from the surface of the pectoralis major. The wound was closed and the arm put up with the shoulder abducted 45 degrees. Active abduction to 45 degrees, flexion to 45, and 60 degrees rotation resulted. Passive abduction and flexion could be obtained to 90 degrees.

Fig. 97 (above). Case 1. E. M. Lateral roentgenogram showing ankylosis before arthroplasty.
Fig. 98. Case 1. E. M. Anteroposterior roentgenogram showing ankylosis before arthroplasty.

WRIST

For most purposes, a wrist ankylosed in hyperextension permits satisfactory function with undiminished strength in the fingers. (Figs. 95 and 96.) Occasionally, however, lateral and flexed motions are desirable, in which case mobilization may be attempted.

Only a few cases of arthroplasties of the wrist have been reported.

Hoffa (86) records a case done by Nélaton and Ombrédanne (124) in 1905. They resected the first row of carpal bones and interposed a tendon-muscular flap. The outcome was poor; ankylosis recurred in four months.

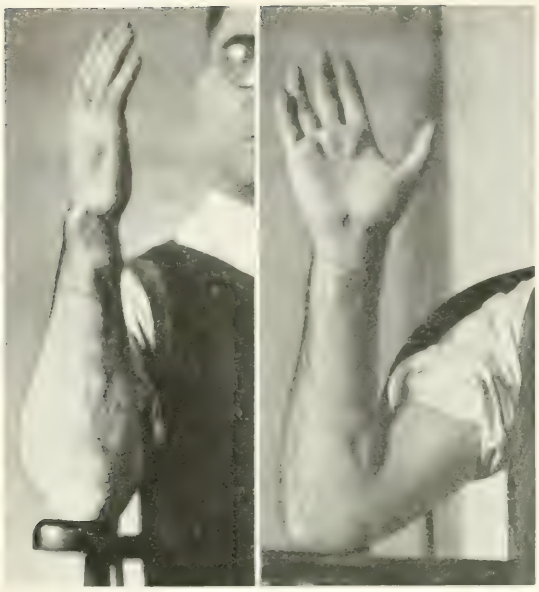
Hoffa (86), himself, did two wrist arthroplasties. In one he inserted a magnesium plate. A fistula resulted, which necessitated the removal of the plate; ankylosis recurred. In the other operation he resected the first row of carpal bones and inserted a fat and fascia flap taken from the proximal side of the wound. Two months after the operation, there was free motion of several degrees. Nine months later there was good mobility in the wrist and excellent function.

Stein (173), in 1907, in Bier's clinic, did an arch-shaped resection of the bones and interposed a muscle flap. In 2 years the passive motion was good, but the function was unsatisfactory, due to the patient's cutting the flexor tendons.

Baer (9, c), in 1909, reported a case of congenital union between the head of the radius and the ulna. Chromicized pig's bladder was interposed. Three months after the operation, supination was possible to 100 degrees, but a twist in the radius prevented it going farther.

Two more cases were cited by Baer (9, a) in 1918. One of congenital synostosis of the radial head and ulna, in which the animal membrane was used, gave voluntary motion of 110 degrees. Marked curvature of the radius made normal conditions impossible. The other case of bony ankylosis between the ulna and radius, when chiseled apart, gave 90 degrees supination and pronation.

L. Durán (57), in 1910, did an arthroplasty, using Baer's membrane. Painless mobility of about 50 per cent of normal resulted in 1 month.



Figs. 99 and 100. Case 1. E. M. Ankylosis before arthroplasty.

Fig. 101 (above). Case 1. E. M. Anteroposterior roentgenogram after manipulation. (MacAusland.)
Fig. 102. Case 1. E. M. Lateral roentgenogram after manipulation. (MacAusland.)

Mention has been made of an arthroplasty by Whitman (193) in 1911, in which a section representing the first row of carpal bones was removed and the deformity corrected. The record is incomplete.

Neff (122), in 1912, outlined his technique of operation on the wrist: A convex incision with the convexity downward through the skin, on the dorsum of the wrist, extending from the ulnar to the radial side; division of the posterior annular ligament and retraction of the extensor tendons laterally; division of the capsule transversely, low down on the carpal bones and dissection of it upward, leaving it attached to the radius and ulna; resection of the first row of carpal bones in an arched direction with convexity upward; inversion of the posterior capsular flap between the articular surfaces. If there is not sufficient capsule a fascia lata flap or rectus aponeurosis may be used. The wound is sutured, and passive and active motion and massage begun on the eighth day.

Murphy (120, f), in 1913, reported three wrist arthroplasties. In one, of infection, an incision was made over the end of the radius on the back of the arm, and a flap of superficial fat and fascia interposed between the radius and the scaphoid. Limited motion resulted; ankylosis did not recur. The second case was that of a woman who had multiple arthritis of 6 years' duration. Elbows, ankles, knees, and hips were involved. On one wrist he made a longitudinal incision over the ulnar styloid process, dissected down on the ulna, and with an elevator separated the muscles, tendons, and arteries. Care was taken not to dissect the periosteum from the bones. A pedicled ulnar flap from the outer surface of the wrist was passed over the ends of the bones, and the tip was brought to the radial side of the joint, where it was fastened. A radial flap was interposed in like manner. The arm was dressed in slight anterior flexion and held in an elevated position.

Five weeks later, Murphy operated on the other wrist, the carpal bones and ulna and radius of which were completely ankylosed. Only a radial incision was made. The lower ends of the ulna and radius were resected about five-eighths inch to three-fourths inch. The division of the ankylosis was semicircular with concavity upward. A flap from the dorsum of the radial side of the forearm was interposed and fastened to the joint capsule on the ulnar side.

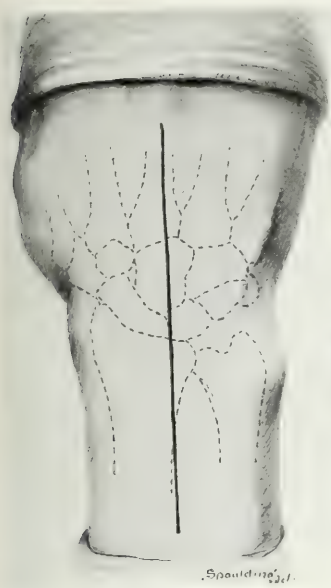


Fig. 103. Line of incision used in author's technique.

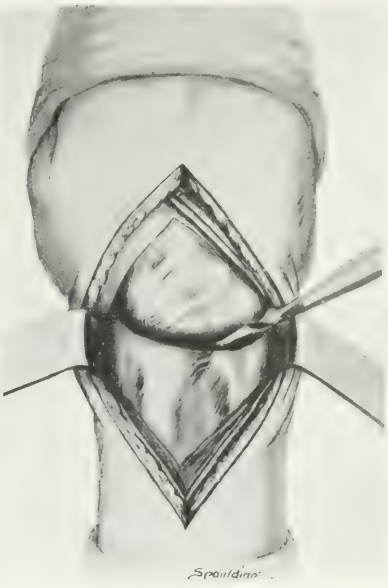


Fig. 104. Cutting out the joint line with curved chisel and removal of a small amount of bone.

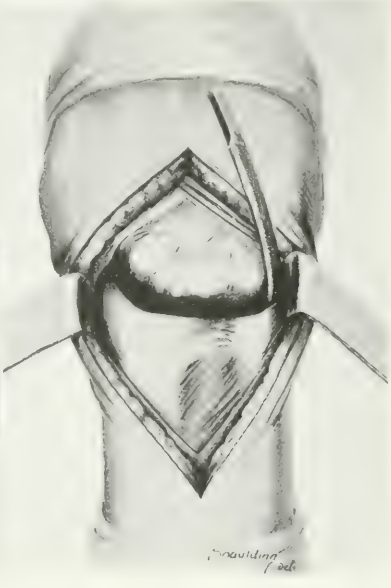


Fig. 105. Making convex and concave surfaces smooth with file.

The right wrist had an almost normal conformation; the left wrist luxated slightly.

In 1922 I did an arthroplasty in the following case:

Case 1. E. M. On May 12, 1922, patient fell through a pane of glass, cutting the right wrist. This was followed by infection, resulting in ankylosis in deformity of 25 degrees flexion. Scars from numerous incisions during sepsis were present.

When I first saw the patient, he had power in all tendon groups, but was unable to make a fist, and the wrist was ankylosed in 25 degrees flexion deformity. Roentgenograms showed considerable atrophy and periarthritic changes with some posterior displacement of the tip of the ulna (Figs. 97 and 98). Manipulation into the hyperextended position was done in August, 1922, and a plaster applied.

August 23, 1922. Patient could bend fingers. Use encouraged while in plaster.

September 25, 1922. Plaster cast removed and hyperextension splint applied. Baking and massage daily. Wrist in good position and, although motion of fingers had increased and the wrist was in hyperextended position, there was no wrist-joint motion (Figs. 99 and 100).

October 30, 1922. Roentgenogram shows ankylosis between the scaphoid, semilunar, and the end of the radius (Figs. 101 and 102). Arthroplasty of the wrist was advised.

November 7, 1922. Operation.

Operative technique—author's method. Posterior incision 5 inches long (Fig. 103). Skin and superficial fascia clamped off with towels. Incision then made over fascia and posterior ligament and both retracted. Common extensors retracted outward, and the extensors of the thumb were retracted inward. An incision was then made over the capsule of the old joint, which was carefully saved and retracted laterally. With a curved chisel the scaphoid and semilunar were separated by osteotomy from the radius. The lower end of the radius was re-shaped and made to approximate as near as possible the normal radial end. One-fourth inch of the carpus was removed and the carpus very carefully rounded to conform to the opposing radial end (Figs. 104 and 105). A piece of fascia was then removed from the outer side of the lower thigh of the right leg and sewed between these surfaces with interrupted chromic gut. It was sutured first to the anterior capsule of the joint, then to the posterior capsule, well over the head of the radius (Figs. 106 and 107). The old capsule of the joint was then closed with interrupted chromic catgut and the skin was closed with continuous catgut. The hand

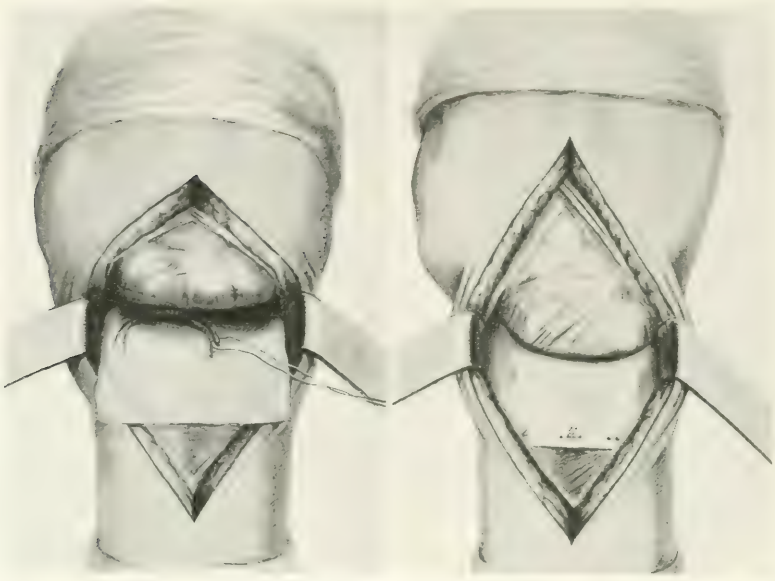


Fig. 106 (at left). Suture of fascia lata to anterior capsule.
Fig. 107. Suture of fascia lata to posterior capsule.

was placed in a cast in hyperextension. The plaster was allowed to remain on 3 weeks and then was split down the side and gentle passive motions begun (Figs. 108 and 109). Active motions were encouraged.

November 20, 1922. Treatment continued. There was no discharge. An X-ray showed separation between carpus and radius as a result of arthroplasty (Figs. 110 and 111).

November 27, 1922. Hand was in good condition. No pain, and use of the fingers had increased. Hyperextension splint applied. To have daily baking and massage with motion.

January 22, 1923. There was 10 degrees lateral motion in the wrist, hand flexion 5 degrees, hyperextension 35 degrees to 40 degrees (Figs. 112 and 113). The patient could almost make a fist. His inability completely to close fingers was due to the old sepsis involving the sheaths of the tendons. He has no pain and wishes to go to work.

I feel that the function will increase as time goes on.

FINGERS

Unfortunately, the phalangeal joints lend themselves poorly to plastic work, due to the fact that, in most cases, the injury which causes the ankylosis also damages the tendon sheaths and the tendons. As a result rapid and extensive atrophy follows, rendering the skin and subcutaneous tissue very delicate. So tender are all the structures with which the operator comes in contact that, even though he uses the best technique, he is baffled. Not until the metacarpal row is reached can the operator feel that the chances of success favor plastic work, and here only in the presence of intact tendons and sheaths.

In 1908, Hofmann (87, b) reported a case of fibrous ankylosis of two interphalangeal joints of the same hand, in which he interposed periosteal transplants from the tibia. Six weeks after the operation there was good passive but no active mobility.

Eloesser (60) secured a good result by implanting a finger joint from the cadaver.

Goebell (72) also obtained a good movable joint by implanting a toe joint in a finger resected for severe arthritis deformans.

Hammesfahr (78), in 1912, reported transplanting the joint of the second toe with capsule and ligaments between the proximal phalanx of the middle hand bone. The result has been very satisfactory; the patient can move the joint freely in all directions; there is only slight lack of bending ability.

In 1922, Oehlecker (126) reported good results, after 6 years, in transplanting the entire finger joints taken from the patients

Fig. 108.

Fig. 109.

Fig. 108. Case 1. E. M. Lateral roentgenogram 2 months after arthroplasty.

Fig. 109. Case 1. E. M. Anteroposterior roentgenogram 2 months after arthroplasty.

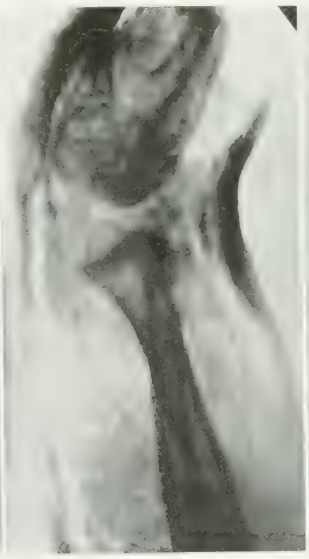


Fig. 110.

Fig. 111.

Fig. 110. Case 1. E. M. Roentgenogram after arthroplasty. (In plaster.)

Fig. 111. Case 1. E. M. Roentgenogram after arthroplasty. (In plaster.)

themselves and from other persons. The results in the autoplastic cases were the better.

Roepke (156), in 1913, operated for finger-joint ankylosis and mentioned that he had success with free fat transplantation.

Payr (134, b), in 1914, recommended arthroplasty of the fingers, using pedunculated implants of flaps of tendon sheath from the palmar side of the hand. He reported two arthroplasties of the interphalangeal joints with favorable results.

Gallagher (67), in 1915, reported the result of an arthroplasty for traumatic bony ankylosis of a proximal interphalangeal joint of the fourth finger. He does not describe his method. In 2 months the patient could lift and carry on the joint 7.75 pounds. There was voluntary flexion to about 45 degrees and extension to about 170 degrees. He has devised a simple apparatus to give proper exercise to the joint.

Hamilton (77) reported success in arthroplasties on the phalangeal and metacarpophalangeal joints. The same principles are involved as in arthroplasty on the larger joints. The incision for all phalangeal joints is made parallel to the long axis of the finger. A mid-lateral incision is made on either side down to the capsular ligament. For metacarpophalangeal joints an incision is made at the junction of the posterior and lateral surfaces on either side. The bones are mobilized by sawing two nicks about one-sixth inch apart. All fragments of capsular ligament are removed. In the thumb he recommends the use of a free flap. Extension is applied by means of a splint and adhesive plaster. Passive motion is instituted after 2 or 3 weeks. A case is cited of virulent polyarthritis which left a man with bony ankylosis of the thumb joint and proximal phalangeal joint of the index finger of the right hand. Within 6 months after arthroplasty the patient was accepted as a naval recruit by the United States Navy.

Verral (187), in 1920, reported his belief that the proximal joints can be treated by arthroplasty, using free fascial graft. Metacarpophalangeal joints afford a good field; for the first, second, and fifth fingers enough subcutaneous tissues can be obtained locally; for the third and fourth fingers he used fascia lata. The flap is cut in a strip 3 inches by 1 inch, folded in half and sewed up into a bag which is slipped over the metacarpal head and secured by catgut.

Fig. 112 (at left). Case 1. E. M. End-result 2 months after arthroplasty. Voluntary hyperextension 35 to 40 degrees.
Fig. 113. Case 1. E. M. End-result plantar flexion, 2 months after arthroplasty.

Hesse (84), in 1922, reported on fourteen cases of finger mobilization. On the middle joint, he made a lateral incision, resected the head of the basal phalanx after separation of the lateral ligaments. In two cases, a layer of periosteum from the tibia was placed over the resected end. In 10 months, one patient had complete working ability of the finger. In 3½ months, the other patient had active mobility of 120 degrees and normal extension. In the twelve other cases, free fascia lata transplantation was used. In ten cases, the patients were benefited, securing satisfactory mobility. In one case, the fascia sloughed and there was no betterment. In another case, there was shortening to about 2 centimeters, active motion in the basal joint 100 degrees, but no movement in the middle joint and strong lateral motion. In four of the cases, it was necessary to remove the fascia.

ANKLE

Ankylosis of the tibio-astragaloid joint, if at a right angle without varus or valgus, is a functional joint with which, in my opinion, we should not interfere. Although a weight-bearing joint may be obtained from arthroplasty, instability, pain, and sensitiveness may result.

In a slight ankylosis of the ankle in good position, there is only a slight limp. If, after experience in years to come, stability may be assured with an arc of motion without pain and sensitiveness, then and only then will arthroplasty be indicated.

Ochsner (125), in 1912, reported that in case operation was necessary for ankle deformities he used the resection method, removing the necessary amount of bone in a transverse line. His cases have been successful, and the patients can usually walk in 2 weeks. In case of severe ankylosis without deformity, he is opposed to arthroplasty.

Ashhurst (7), in 1915, cited the case of a boy with bony ankylosis of the right ankle, with the foot in a position of equinus at 140 degrees with the leg. There were deep scars on the leg and foot. Ashhurst incised down to the bone on the outer side of the tarsus from below the external malleolus to the extensor tendons. The soft parts were raised from the bones. Another incision 1 inch long was made on the inner side of the ankle joint in front of the internal malleolus and parallel to the tibia. The wounds were joined by burrowing. A wedge of bone, cut with its base on the dorsum of the tarsus and its apex at the posterior surface of the ankle joint, rendered the foot movable. Fascia lata from the left thigh was inserted. The result was free voluntary motion of about 10 degrees, with the foot not quite at a right angle. The hallux valgus caused extreme deformity.

A second operation was performed in which the head of the metatarsal was removed and the toe put in position. The tendon of abduction hallucis was inserted. The tendo achillis was lengthened by the "Z" operation. One month later there was free voluntary motion in the ankle from 85 degrees to 95 degrees and passive motion from 85 degrees to 110 degrees. Dr. Ashhurst looked for further improvement.

One would hardly feel that 10 degrees motion in an ankle warranted the attempt to mobilize it. An ankylosis, corrected into proper position, would be useful and mobili-

Fig. 114. Line of incision as used by author.

Fig. 115. Flap dissected back.

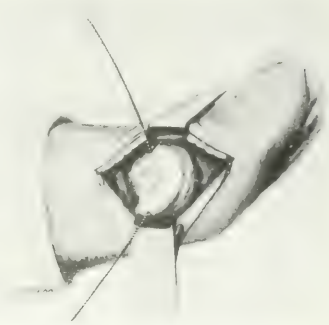


Fig. 116. Excision of small amount of bone.

Fig. 117. Rounding of distal end of metatarsus.

Fig. 118. Filing and smoothing of metatarsal shaft.

Fig. 119. Flap sewn in place.

zation might result in a sore and painful joint.

Steindler (174), in 1916, reported two cases in which pedunculated fascia flaps were used. One case was the result of a fracture of the astragalus and collum astragali, with supination deformity, and the other the result of fracture of the internal and external malleolus and impingement of the body of the astragalus on the fractured end of the tibia and fibula. No results were recorded.

Ceballos (30), in 1917, used a free flap of fascia lata in a case of complete tibiotarsal ankylosis in a right angle. No result is given.

Baer's (9, a) one case of arthroplasty on the ankle was reported in 1918. It is of interest, as a bone graft of fibula was inserted before the arthroplasty could be made. The membrane was inserted between the astragalus and the fibula. Voluntary motion of 30 degrees was obtained, and the patient walks with comfort.

Reich (150), in 1919, issued his views on arthroplasty of the ankle joint, which he considered one of the most satisfactory mobilizations. Observations were made in various cases operated upon, which showed that the desired 20 degrees to 30 degrees range of mobility was not obtained. This, Reich believed, was because in operation the tibia was again made concave and the astragalus convex. As the mobility attained by the natural joint is closely connected with the height of the astragalus over the posterior segment of the foot, the slightest diminution of this height interferes with the movement, for the margins of the concave plane of the tibia strike against the astragalus anteriorly and posteriorly. In arthroplasty a decrease in the height of the astragalus seems unavoidable.

Reich recommended an inversion of the natural form of the portions of the joint, making the surface of the tibia convex and the astragalus concave. The flaps of fat are laid

Fig. 120. Case 1. D. R. Anteroposterior roentgenogram 20 months after arthroplasty.

Fig. 121. Case 1. D. R. Lateral roentgenogram 20 months after arthroplasty.

between the surfaces. With this inversion, the axis of the joint mobility will be changed downward without the lateral ligaments being adapted to it, but this new mobility is not so much of the joint as of the rocking motion which furnishes a useful substitute for the former.

METATARSOPHALANGEAL JOINTS

The metatarsophalangeal joints, with the exception of the first metatarsophalangeal joint, never call for arthroplastic measures. These joints, in fact, are rarely stiff. The fascia-flap method gives an excellent result in the operation on the first metatarsophalangeal joint.

Operative technique—author's method. After thorough preparation of the part and the application of a tourniquet, an incision is made, beginning on the lateral aspect of the first phalanx and extending parallel to the shaft, curving to the lateral dorsal surface over the region of the joint and then back to the lateral aspect of the first metatarsal (Fig. 114). This flap is then dissected down and retracted with double hooks. A curved incision is then made through all remaining tissue, including bursa, capsule, and fascia. This incision begins near the base of the first metatarsal on the lateral plantar surface and sweeps about one-fourth inch over the base of the first phalanx to a corresponding position on the lateral dorsal aspect of the first metatarsal. The flap is dissected back, exposing the old joint (Fig. 115). About five-eighths inch of the head of the first metatarsal is then removed and all edges smoothed with a file or shoemaker's rasp (very important) (Figs. 116, 117, 118). A chromic suture is then passed from the plantar surface into the cavity and through the flap, making a mattress suture, and then the needle is passed through the cavity to the outer plantar surface and the flap firmly pulled into the cavity over the end of the metatarsal head (Fig. 119). The skin is closed with continuous catgut and a dry dressing applied. The toe is bandaged in inversion and slight plantar flexion, opposite to the usual deformity.

Weight-bearing is allowed in 2 or 3 weeks, at which time passive motion and hydrotherapy are of use. Activity depends upon the amount of swelling and pain, and motion is limited accordingly. The results of mobilization of the joint are excellent.

CASE 1. D. R., age 45. In February, 1921, I operated for a case of double hallux valgus, using the technique I have outlined.

For years this patient had complained of increasing pain and stiffening in the toe joints. More recently she complained of loss of motion and enlargement of the joints. Physical examination showed a marked exostosis on the top and inside of both toe joints, with limited motion. Excision of the distal head of the first metatarsus and insertion of a bursal flap was advised.

February, 1921. In the operation 0.5 inch of the distal head of the first metatarsus was removed.

. April 8, 1921. Good motion. Anterior arch padding. Subsequent convalescence without pain or swelling. Elastic cuffs advised.

November 17, 1922. Motion perfect. (Figs. 120 to 125.)

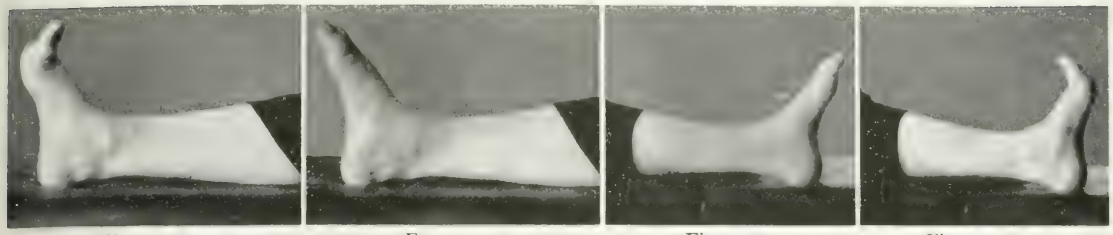


Fig. 122. Fig. 123. Fig. 124. Fig. 125.

Fig. 122. Case 1. D. R. Toes of right foot in dorsi-flexion 21 months after arthroplasty.

Fig. 123. Case 1. D. R. Toes of right foot in plantar flexion 21 months after arthroplasty.

Fig. 124. Case 1. D. R. Toes of left foot in plantar flexion 21 months after arthroplasty.

Fig. 125. Case 1. D. R. Toes of left foot in dorsi-flexion 21 months after arthroplasty.

Murphy (120, b), in 1913, secured good motion in 18 days in a case of ankylosis of the phalangeal and metatarsophalangeal joints. Leucorrhœa of 4 years' duration had been the cause of stiffness. Murphy made an incision on the dorsum of the toe and used a flap of fat and fascia from the inner side of the foot with base upward.

In 1916, Murphy (120, b) outlined his operative technique for hallux rigidus as follows: A curved incision with convexity outward along the extensor tendon; incision of the tendon to elongate it; metatarsal head resected and bursal capsule used as the interposing flap.

Putti (145, a), in 1913, reported an arthroplasty on an ankylosed metatarsal phalanx of the hallux. He made a longitudinal cut on the internal side of the metatarsal phalanx, removed two large sesamoids that contributed to the stiffness, removed all capsule, and interposed a flap of fascia lata, wrapping the two surfaces. The extensor tendon was shortened. A plaster cast was applied to keep the hallux in a dorsal position. The postoperative treatment was regular. The stitches were removed on the ninth day, and gentle passive movement was begun.

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Note.— Figures 56 to 63 and 87 to 92 are reproduced from the *Surgical Clinics of John B. Murphy;* Figures 64 to 67 from *Ann. Surg.;* Figures 42 to 53 from *Chir. d. org. di Movimento.*

ARTHROPLASTY[1]

By Dr. P. SANTY, Lyon, France

THE very particular manner in which we have viewed the question of arthroplasty in this report must first be explained. The ideas we wish to broadcast are not simply our own, but rather those of a school. We shall discuss especially what surgery at Lyon has evolved in the mobilizing treatment of ankyloses, in applying the methods of joint resection outlined by Ollier, and how these methods appear at this time to a surgeon who did not know the founder of the method but who has been raised in the tradition of this school.

Arthroplasty as performed nowadays seems to us the result of the infinite number of attempts which surgeons and experimenters have performed to give original mobility and solidity to ankylosed joints.

The many reports written about the treatment of ankyloses, of which certain ones (as the report of Baumgartner at the French College of Surgery in 1913) are very full and rich, show conclusively, and it is quite in accordance with our ideas, that the question has been almost decided, at least as regards treatment of the upper extremity. Beginning with the first investigations which were undertaken, the subject has been very complicated because success did not follow the interposition of different kinds of tissues and articular transplants. We have now returned to a very carefully studied and precise technique which makes failure exceptional, but which in many ways is not so very different from that used in the beginning of our work.

To Ollier is due the credit of first realizing the possibility of mobilizing certain ankylosed joints and putting his method into practice. His ideas have been regularly and precisely developed, thanks to modern surgical technique, and form the basis for arthroplasty. The method of aponeurotic interpositions seems to have taken its place in the realm of practicable operations.

Our co-reporters may bring before us important personal statistics which better than all comment will enable us to appreciate the value of the procedures they employ. It would have been impossible for us, even had we made a collection of all the French observations published, to submit important and conclusive statistics. In fact, up to the last few years, arthroplasty has been undertaken among us only timidly and in a few isolated cases.

On the other hand, it has been interesting to us to endeavor to show that Ollier's technique is still upheld as is shown in the different ideas expressed regarding mobilization of ankylosed joints. Since its creation this technique has been especially bettered by the general improvements in surgical technique and aseptic operating, but on the whole has remained very like that which Ollier described at length in his treatise. Aside from the knee, for which the comparison does not hold good, we are able to show that mobilizing resection and anthroplasty give rather close results, differing chiefly in the postoperative course. In the light of these facts it is apparently important to see what part of the old method holds good in comparing the results obtained with it to those actually obtained from arthroplasty by means of aponeurotic interposition.

The general principles on which Ollier insisted from the time of the announcement of his conception of the mobilizing treatment of ankylosis by resection were as follows: Joint resection can result in the formation of a new joint both movable and solid provided the removal of bone is sufficiently great to permit a free play of the resected ends on each other. This removal should include all ossifiable tissues such as remains of the joint capsule which are greatly modified in bony ankylosis and which are liable, if allowed to remain, to lead to bony union. This removal Ollier defined under the name of interrupted subperiosteal resection.

Attributing to the muscular insertions a preponderating rôle in the reconstruction of

[1] Presented before the International Surgical Society, London, July 16–21, 1923. Translated by Kellogg Speed, M.D., F.A.C.S., Chicago.

the bone ends and the solidity and mobility of the new joint, he has prescribed for each joint the best means of trimming off the articulations so that perfect conservation of the juxta-articular muscle insertions may be maintained.

Finally after studying the postoperative results, by means of electric stimulation and massage of the muscles to preserve their contractility, he left nothing to be desired in his treatment for joint mobilization which aimed at securing for a joint its original mobility.

ANKYLOSIS OF THE SHOULDER

Ankylosis of the shoulder is a condition for which the surgeon is infrequently consulted, because, in most of the cases, there is so little disturbance of function. "Thanks to the constantly increasing movement of the scapula the patient can follow a manual trade, which may even be laborious, and he is inconvenienced only in his arm movements, especially in abduction and elevation."

When one can promise the patient a joint which is both solid and movable as well as having increased function, operation will be offered legitimately, and Ollier believes that the results obtained are evidently preferable to ankylosis. However, in many cases of ankylosis of the scapula and humerus, satisfactory use of the upper extremity is possible, thanks to the movement of the scapula which gradually increases and compensates to a certain extent for the impotence which results from the scapulohumeral fusion. Especially is this true if the humerus is fixed in such a manner that the movements of the forearm are easily accomplished and over a wide enough range when the elbow is flexed at a right angle. This presupposes that during the process of the disturbance or in the course of the ankylosing trauma, one has taken care to immobilize the arm in slight abduction and external rotation.

However, there are cases in which these precautions have not been taken and one finds the arm in a position of internal rotation which, even when the scapula aids, results in the forearm and hand being held in contact with the anterior surface of the chest when the arm is in an attitude of rest alongside the body. For writing or feeding purposes, these arms are almost, if not quite, useless.

In such cases, without mentioning arthroplasty, two operative procedures are possible: osteotomy and resection.

In one case of Leriche's which I saw in 1919, a subcapital osteotomy followed by immobilization in slight abduction and external rotation, thanks to the perfect mobility of the scapula, gave a very satisfactory functional result. If, however, the scapula does not have free movement, resection can and should give satisfaction.

Although rare, from time to time instances of fixation of the scapula have been observed among soldiers wounded by projectiles which, after having traversed the shoulder joint, have shattered the border of the scapula and carried out large masses of soft parts at the wound of exit. In such lesions cicatrization of the wound results in scauplohumeral ankylosis and locking together of the thorax and scapula on account of adherence to the thoracic wall of the anterior and posterior scapular muscle masses. In such wounded men it is important to mobilize the shoulder joint; resection accomplishes that perfectly.

Resection will be attempted only if the condition of the shoulder girdle muscles indicates the possibility of securing active mobility. Ollier emphasizes the importance of care in resecting the soft parts, periosteum, and joint capsule and prudence in resecting the bony part proper so that only so much as is necessary be excised to obtain both mobility and solidity. It is important to specify the point at which resection of the humerus should begin. This should be in the juxta-capital area and should extend if possible in the depression of the anatomical neck, excising the internal part of the greater tuberosity region in such a manner as to permit freedom of movement in abduction. After resection it is of great advantage to mold the upper end of the humerus. In the classical technique the manœuvres of mobilization are progressive and, with the osteogenetic restoration of the epiphysis, lead slowly to the functional adaptation of the

upper end of the humerus. This complement of the operation itself, which is easily performed, will surely simplify in a rather large measure the first attempts at mobilization by hastening the reciprocal adaptation of the surfaces of the new joint.

Resection will yield good results only when followed by immobilization in abduction and slight traction, with the arm suspended in a sling. Such procedures permit almost immediate passive mobilization of the resected joint. In certain war wounds, the results which follow resection at the shoulder joint when no infection develops are such as to convince one that resections are better than simple ankylosis of the shoulder joint in a good position.

ANKYLOSIS OF THE ELBOW

When Ollier first advocated his method, in 1869, and carried out his technique of resection, his work on the elbow joint yielded results which completely realized his expectations. What can we add to the indications he prescribed? "Resection gives me a limb more useful than an elbow ankylosed in the best position. Ankylosis of the elbow at a right angle or slightly extended should not be considered as a happy result which must invariably be considered as satisfactory. One is forced to demand as well movement in the joint if the patient is of an age which would insure success from operation, and of a social status which makes operation necessary." As contra-indications Ollier would consider only the age of patient and the ability of the musculature to resume its function. If in the presence of ankylosis at a right angle, operation was considered contra-indicated because of the social status of the patient, such should not hold true in the presence of ankylosis at an obtuse angle or if the arm is in extension, because in such cases the indication for operation is urgent and operation should be done as soon as possible to avoid an increase in the muscular atrophy.

The possibility of producing an ankylosed elbow with double mobility (radio-ulnar and humero-ulnar), by joint resection according to Ollier's method, was an established fact when its originator described it in his treatise on resections, and has only tended to strengthen the practice of his school. However, resection of the elbow is not always considered favorably and the violent attacks upon its use by certain surgeons, during the last years of the war and since, make discussion worth while.

In general the great objection offered by the opponents of the method is the danger that flail elbow may follow resection. However, the results secured by Ollier and the large number of his pupils should convince one that instead of incurring the danger of flail elbow, correct and typical resection is apt to show as its main drawback, a tendency of the joint to stiffen up again, and the surgeon must struggle against this for many weeks.

It is very interesting to note moreover that the fundamental principles laid down today by those who advocate arthroplasty as indispensable factors in securing success are quite the same as those defined by Ollier in describing his mobilizing resection of the elbow joint, namely:

a. Removal of at least 5 centimeters of bone in most cases, sometimes more.

b. Sub-periosteal interrupted resection by excising all around the joint every bit of the excess thickened periosteum, and remnants of joint ligaments and capsule which have undergone osseous infiltration.

Although it is not part of this paper to discuss operative technique, it seems essential to review the important points very briefly. The posterior external incision described by Ollier should be used. It permits the operator to inspect the wound carefully and offers no serious inconvenience when one completes the resection by the bony release from within at the level of the elbow. The least satisfactory point in the technique is perhaps the liberation of the insertion of the triceps by means of the periosteal elevator. This insertion is nearly always shredded by the elevator so that only a small band of doubtful character is preserved. The resection and saving of a small layer of the olecranon, which can later be reimplanted on to the ulna along with the triceps tendon, certainly constitutes a very appreciable improvement in

the operative technique and deserves wider use. It is nearly always possible to break through the ankylosis by means of a rasp or chisel if simple flexion of the forearm does not suffice. The next step in the operation is resection of the bone. It is important to make this as typical and clear cut as possible. On the humerus, resection should be made at the thickening of the condyles or just above them at a point where the diaphysis begins to enlarge; intra-epicondyloid section is the best (Leriche). On the forearm side, resection should be carried below the coronoid process in the neck of the radius. In this technique removal of the radial head is without doubt an essential factor in restoring pronation and supination. Resection of the radio-ulnar synostosis by means of the chisel, as proposed by Putti, could be of value only in very limited fusions between the bones. These resections can result only in greatly helping the remaining tissues in adapting themselves to their new function. Trochleaform resection of Defontaine is not without interest; likewise, oblique section of the elbow leaving an olecranon mortise is advantageous.

Ollier made a separate subdivision for ankylosis following unreduced dislocations of the elbow. Such cases are accompanied by most extensive peri-articular ossification and show the greatest tendency to re-ankylosis after resection, so that he performed only a humeral resection in order to preserve all the force of the triceps by allowing its insertion to remain intact. Experience gained in the war has shown that partial resections give uniformly bad results, especially on account of the tendency to re-ankylosis which endangers even the superior radio-ulnar joint.

It must be kept in mind that resection for ankylosis must be liberal. Failure to do so, we shall see in studying results, means re-ankylosis. The care given the resected elbow and the course in the weeks following operation are of great importance from the standpoint of results. An aseptic course and union *per primam*, by reducing inflammatory reaction, have most certainly modified the functional prognosis of mobilizing resections. Inflammatory reaction produces a great osteogenetic tendency as Ollier observed. He guarded against it by using antiseptic dressings and drainage.

We must not feel, however, that the great difficulty against which we must constantly struggle is exuberant bony regeneration which follows resection. Two means of avoiding this regeneration are either mobilization or complete rest in plaster of Paris, and these means are available to every surgeon and he should consider them from all angles. In 1889 Ollier wrote: "Now everyone is convinced of the necessity of not letting joints stiffen and of mobilizing them as soon as possible. This idea is so generally and emphatically advocated that it has been overdone, and while it does not seem necessary to reverse our ideas regarding mobilization, we must warn young surgeons against any erroneous interpretation they may make of them. It seems to us that everywhere near and far surgeons are overdoing; they are so convinced that mobilization is necessary that they treat the patient roughly and when he will not permit that then with delicacy. Many times we have seen deplorable results from too great zeal. We have seen joints become ankylosed after brutal movements. It is bad practice to attempt to obtain in 8 days what ordinarily requires months to secure. It is not a question of overcoming resistance or of breaking up adhesions; it is the problem of causing the formation of an apparatus for sliding movement and of organizing an interlying serous surface."

There is nothing to add to Ollier's statement as to the manner in which resected joints should be mobilized. It requires at least 3 months of patient effort to secure results and improvement progresses both as to active and passive movements. At times, especially in the young, some time during or at the end of the second month, when the process of bony repair is at its height, the movements will suddenly become stiff and the elbow grows warm and painful. When this occurs one should immediately place the arm in complete immobilization in a plaster gutter and let it remain there for 8 to 10 days, when the joint will be found to have regained its former mobility and may again be mobilized (Leriche). Under the

supervision of the surgeon, mobilization should be practiced for 3 to 3½ months; after this the patient may continue his exercises, consulting the surgeon at intervals.

From an anatomical standpoint, the result may be quite perfect. In 1912 Vallas exhibited before the Surgical Society of Lyon a specimen secured 4 years after resection for bony ankylosis following rheumatism. The specimen showed bony restoration, a capsular ligament, and even a synovial membrane. This was particularly interesting inasmuch as there was a very unique unpartitioned joint cavity with very simple and very solid ligamentous reconstruction about it. The result was perfect funtionally. Ollier's treatise contains examples of excellent results after mobilized resection for ankylosis, some of which were obtained after several unsuccessful attempts followed by re-ankylosis.

However, as he himself states, it was always necessary to use ample and prolonged drainage because of the imperfections in operative technique at that time. The results of his operations were very rarely rigorously aseptic, that is, there was always a more or less intense inflammatory process which lent itself as a favorable factor for the reformation of abundant bone.

Today, when we can be reasonably certain of our operative technique and can close the resected joint without drainage, we are assured of more simple and more rapid results, and instances of re-ankylosis are less often found, while the average results are better.

We shall not discuss the results of experimental research work from multiple or nonhomogeneous sources. Reports of such work abound everywhere, and it is interesting to note that the surgeons who have done simple resections and resections with interplaced tissues for ankylosis of the elbow agree that the results are about equal. Thus, Chaput in July, 1917, brought before the Surgical Society of Paris three cases which had been treated for bony ankylosis. Two of them had been operated upon by simple mobilizing resection and the third by interposition of a fat transplant. The results in the three cases were satisfactory, and Chaput concluded that tissue interposition was useless. L. Berard and Sencert[1] have published similar results. Nove-Josserand, in 1893, reviewed the subject and came to a conclusion favoring complete extensive resection. He does not appear to have changed his opinion, as shown in a case of resection with interplaced tissue which he recently presented before the Surgical Society of Lyon.

During the war Leriche had the opportunity of working on many wounds of the elbow and of observing the different stages of evolution, and he published a series of very excellent results after extensive resections of the elbow for post-traumatic bony ankylosis. In a report presented in 1919 at the Sixth Interallied Surgical Conference he concluded as follows: "I have resected fistulous ankyloses of the elbow, painful ankyloses, ankyloses in vicious positions and some ankyloses in good position in patients who desired joint movement. In 15 cases I used Ollier's resection. Only extensive resections gave me good results; when I tried to be conservative, ankylosis returned. Out of the 15 cases I obtained good results in 9, 2 of which were very good, 2 were insufficient, and 4 re-ankylosed."

Must one then conclude that arthroplasty on the elbow is fruitless and should one remain faithful to resection alone? The facts we have mentioned, together with many others, show that Ollier's resection is sufficient to obtain the result desired, and that it is possible to obtain this result in a simple manner, and the technique is easy of execution.

It would seem that aponeurotic interposition and molding of the osseous surfaces have their advantages in gaining time and in smoothing over that trying period for both patient and surgeon during the progressive mobilization in the first few weeks. Anthroplasty does not dispense with long and painstaking postoperative care, but it does make it less laborious and avoids those outbursts of inflammatory reaction which often threaten and sometimes compromise the results of operation if resection is done without flap interposition.

[1] Société de Chirurgie de Paris, 1918, June 5.

ANKYLOSIS OF THE WRIST

Mobilization for ankylosis of the wrist is seldom indicated, because a wrist ankylosed in good position—half extension with persistence of the motions of pronation and supination—is often compatible with considerable functional use of the hand.

It is very different when the wrist is ankylosed in flexion with lateral deviation and limitation of finger movements on account of injury to the tendons. Such a case is almost always caused by the sequelæ of radiocarpal trauma, and its treatment must necessarily become a part of the delayed treatment for fractures and dislocations of the carpus, and often fracture of the radial epiphysis. In an instance of this character, the loss of function is concerned as much with tendon disturbance as with adhesion of the median nerve, and operation makes it possible to treat the whole difficulty.

Here again orthopedic resection of the wrist has a very interesting history and roentgenographic study of carpal lesions in traumata of the radius has enriched it by numerous observations.

In two published observations in his treatise, Ollier has described the method of treatment and shows the possibility of bringing about mobility along with functional power in the hand by means of total resection of the carpus, extending or not extending to the radial epiphysis. Other types mentioned are those resulting from inflammatory ankylosis, old osteomyelitis, and the ankyloses of rheumatism.

In 1908 Vallas[1], by means of six observations, established the necessity for complete carpal resection to restore mobility to wrists completely ankylosed. However, one must not overlook the fact the such a resection is to be used only on real ankyloses, that is, total ankyloses of the carpal and radiocarpal joints, verified by roentgenogram. With the exception of this class of cases, partial resection limited to the first row of the carpal bones or particularly to the bones directly concerned in the trauma, the lunate and navicular most often, will suffice, especially if the trauma is relatively recent and if the loss of power is due only to incomplete stiffening and to pressure on the surrounding parts by deformed or displaced carpal bones. It resolves itself into a question of great difference in indications rather than a question of different treatment for identical lesions.

Can gonorrhœal ankyloses and those following suppurative arthritis when the hand is placed in a vicious position, be benefited by extensive carpal resections? Frequent changes in the muscles and tendons must greatly reduce the indications in these cases.

The results of orthopedic resections of the wrist depend more than is the case with all the other joints on the condition of the muscles and tendons. Skeletal shortening of from 3 to 4 centimeters which results but rarely from carpal resection necessitates first of all a functional adaptation which will terminate satisfactorily if the muscles and tendons are intact. However, Ollier describes a procedure for shortening tendons which is useful whenever the resection is carried up to the radial epiphysis and he emphasizes the importance of the bony shortening. On the other hand, if improvement has previously been obtained, if the tendons are slightly movable, and if there exists great muscular atrophy, the results obtained will show the effect.

At the wrist as at the elbow the parallel between orthopedic resection and arthroplasty is easily sustained, with this important fact in favor of arthroplasty by interposition, however, that it permits a less extensive resection of the wrist (limited to a single row of bones) and interferes less with the use of the hand as a bony lever.

Moreover, it unquestionably favors mobilizing movements from the start and simplifies the postoperative care: a fact clearly demonstrated in a recent case. The remote results of resection should not be very different from the results of arthroplasty.

ANKYLOSIS OF THE HIP

The respective operative indications as a result of the many varieties of ankylosis of the hip are such that, even now in spite of all the progress made along this line, the surgeon hesitates to use the mobilizing operation except in a very limited number of cases.

[1] Société de Chirurgie de Paris, 1908, Jan. 29.

At the hip, as at the knee, the problem of obtaining mobility and solidity at one and the same time is a particularly delicate one. It is frequently the case that the surgeon prefers to leave the limb as it is, if the position of the joint is good, if the thigh is straight out, and slightly abducted. If the angle of the joint is vicious, it is considered good practice simply to change the position. Osteotomies are performed with an infinite variety of resulting positions of the leg according to the prevailing fashion. The tendency to avoid the joint zone itself and to attack only the trochanter or the trochanteric region as has been carefully specified by Ollier is very well explained by the fact that operative trauma, even an osteotomy, may cause, without any hope of direct cure, the lighting up of a tuberculosis—a frequent cause of the ankylosis.

It is this same dominating thought which has caused the attempts to perform indirect mobilizing operations such as the para-articular enarthrodeal osteotomies of Rhea Barton and of Vincent[1] to which Rocher[2] added interplaced muscle.

If Ollier declared himself as less in favor of direct operation on an ankylosed hip for fear of altering its mobility only at the expense of its length and the solidity of the limb, he none the less studied the possibility of it, and showed under what conditions wide resection of the hip, the technique of which he described, would bring the desired result.

The typical indication for such resection is ankylosis of both hips straight out. He formulated a plan by which to treat such disability which was everywhere copied and followed, up to the time of the appearance of modern operations for mobilizing joints. He advised resection first on the side where the muscular atrophy was the least pronounced and where the best conditions for the re-establishment of movements were found. Following this a subcervical osteotomy on the opposite side should be done. He believed that failure of the first attempt with re-ankylosis or stiffening did not contra-indicate another attempt at typical resection of the second joint operated upon.

[1] Vincent, December 11, 1890.

[2] Rev. de chir. ... April 10...

Resection, such as Ollier described for the hip, can claim to result only in a movable hip in the face of a considerable number of bony excresences, so that weight is carried often on the partly resected greater trochanter. The fact remains as a principal factor in the mobility that there is complete loss of contact between the upper end of the femur and the acetabular area. But this very condition is also the cause of the ascent of the liberated femur toward the iliac fossa in spite of precautions taken during the operation to reform an acetabular buttress out of the periosteal and capsular débris rolled up over the upper margin of the acetabulum and to maintain the leg in a long-continued abduction by means of strong traction.

It is not our purpose to enter here into the technical details of resection for ankylosed hip, but it is worth while to call attention to the difficulties which the operator encounters. As soon as he has reached the neck of the femur, it is easy to continue on to the acetabular region and to break through the ankylosis with a chisel, or first to resect the neck so that attack may be made secondarily on the ankylosis. Sometimes it is found, however, that the bony mass which binds the femur to the pelvis makes the landmarks unrecognizable. It increases the size of the joint out of all ordinary proportions and changes its level, so that the freeing of the head becomes very difficult. For extirpation of the bony mass resulting from fusion of the head of the femur and the acetabulum, "peri-trochanteric arthrotomy" (Lorentz) is used. It is very difficult to perform the molding of a new joint in such a case.

In view of the facts mentioned, there seems no doubt that instead of extensive resection of the hip with its uncertain and in all cases very imperfect results, plastic arthrotomy followed by the interposition of tissue which has given such excellent results in the hands of Murphy, Baer, and Putti is the preferable operation. On the other hand when we find that the molded bony mass offers considerable resistance because of its volume and consistency, one is much inclined to employ the simpler technique which still assures a satisfactory result.

It has been my opportunity to observe with Leriche[1] two cases of bilateral ankylosis of the hips in patients on whom an extensive resection of the cervico-acetabular bony mass has given satisfactory results with a movable new joint which allowed between 40 and 45 degrees flexion of the hip on the pelvis. It is extraordinary to note that in one of these two patients the joint thus resected had undergone 7 years previously an arthroplasty according to Murphy's method, and after several months of apparent success had terminated in a new ankylosis in the course of an attack of infectious disease.

In the hip, then, in most cases, extensive subperiosteal resection gives mobility only at the price of deformity and instability of the lower limb, which is considerably restricted in its function. Such resection should be reserved for use only in those cases of extensive peri-articular ossification which expose the technique of modern arthroplasty to great difficulties and hindrances and which permit one to obtain with wide subperiosteal resection firm new joints of the correct range of motion.

ANKYLOSIS OF THE KNEE

Our ability to trace a still existing parallel between mobilizing resection and arthroplasty ends completely in its application to the knee joint.

As has been repeated by former authors many times, many French surgeons since the time of Ollier, and his own school at first, believed until recently that ankylosis of the knee in good position—that is to within a few degrees of complete extension—was the curative result to seek and maintain in all joint disturbances which threatened the integrity of the articular surfaces. As late as 1913 the French Congress of Surgery at the close of its discussion admitted that rectilinear ankylosis of the knee was to be held in respect.

As Tavernier emphasized, in his report at the meeting of the French Orthopedic Society in 1921, Ollier, who obtained experimentally on animals extremely interesting results in the restoration of movable joints after resection, had never, outside of a case of limited ankylosis between the patella and femur, dared to apply to human surgery the technique which had given him a glimpse of the possibilities to be attained from its use. What he stated after defending the method "from the viewpoint of the real interest of the patient, bony welding after complete bony resection," was: "But is this the last word in surgical art and should we forever renounce the attempt to find for the knee what one obtains so regularly for other joints, for the elbow and for the wrist?"

The two great difficulties which caused so many operators desirous of improving ankylosed knees to hesitate so long were the problems of obtaining movement in a positive manner as well as movement associated with a satisfactory joint stability. In a word they wished to obtain, as Payr said, in speaking of the patients on whom he had operated, not a joint *de luxe* but a truly first-class joint capable of doing its work.

Now the problem seems solved. The most convincing statistics of Putti, Baer, Murphy, and Payr show conclusively the possibility of restoring movement to an ankylosed knee by means of an arthroplasty including the interposition of tissue. However, the perusal of these statistics and numberless reports shows first of all that the results vary according to the methods used and the operators. Besides indications for operation or rather the contraindications are very different and vary according to the author.

There is a great variety of causes of ankylosis of the knee, the causes being even more numerous perhaps than for other joints. They may be classified under the following heads: tuberculosis, infectious arthritis, gonorrhœal arthritis, traumatic arthritis and osteomyelitis, polyarticular diseases resulting in ankylosis. A tuberculous etiology is considered by some as a positive contra-indication to arthroplasty (Putti, Lexer), by others it is considered as yielding very unfavorable results (Murphy), others on the contrary (Baer and Payr) have secured good results with arthroplasty after this disease.

A similar diversity of opinion exists which has as its basis the anatomical character of

[1] Société de Chirurgie de Lyon, 1921, April 14.

the ankylosis; the fibrous or bony nature of the synostosis has also been the subject of diverse views since Putti announced that he would rather deal with a bony ankylosis with atrophied muscles than with the fibrous form even when the muscles retain a more vigorous condition.

Finally the factor of the position of the ankylosed joint has been considered as important. All operators who have performed arthroplasty prefer to operate on a knee which is completely extended or only slightly flexed. The position of pronounced flexion is a source of great difficulty because it involves wide bony resection and a compensatory lengthening of the flexor tendons. However, it cannot be denied that one will always be strongly inclined to advise an operation for mobilization in the presence of a vicious position, even if the operation finally results in the straight position in case of failure.

This brief statement of the various factors which guide the surgeon in making his choice of operation simply aims to set forth what possibilities other operations than arthroplasty offer for ankylosis of the knee.

Cuneiform resection will certainly improve many vicous ankyloses flexed in a bad position, where one feels that operation for mobilization would not be beneficial, possibly on account of the extreme degree of flexion or on account of the wretched state of the muscle or an account of the cicatricial contraction of the coverings of the joint. Quite recently Professor Berard reported before the Surgical Society of Lyon a series of observations on ankyloses in flexed positions following tuberculous arthritides of childhood. He straightened out the flexed limbs means of cuneiform resections, and, in his opinion, considerable improvement followed the operation.

As a disadvantage to arthroplasty surgeons have mentioned the fact that because of the extreme difficulty in performing the operation it is necessary for the surgeon to specialize in this one limited field so that he may become efficient in performing the various technical manœuvres. In addition, Putti mentions specifically that he never undertakes operations of this character except on carefully selected patients and after an extensive knowledge of the surgery of joints in general. Every one will subscribe to these precautions.

I have had an opportunity of collaborating with Leriche in two arthroplasties done according to Putti's technique. The first case was one of gonorrhœal arthritis really a little too recent, and one which resisted a prolonged course of vaccine treatment before the operation. As the psychic condition of the patient was of no help in the post-operative treatment, the ankylosis rapidly reformed. The second case in which the patient suffered from multiple ankyloses gave a very fair result.[1]

Recently we[2] operated together upon a young girl suffering from a traumatic ankylosis in the extended position, and the result after 3 months promises to be very favorable since she now has active flexion of more than 45 degrees.

It is true that one can profit only by familiarizing himself with the necessary operative technique and that can be had only by much experience in performing arthroplasty.

Other published French cases, rather few in number, but nearly all favorable, can not help but encourage their authors to multiply their attempts. Cases reported by Tavernier, Mauclair and Rocher at the French orthopedic meeting are instructive. They were not all successes but they bore witness to the possibility of arriving rapidly and surely at results comparable to those reported in the statistics quoted above. The case on which Lenormand operated, after Murphy's method, and which he showed before the Paris Surgical Society on the 28th of June, 1922, was an excellent result, of 19 months' standing and with a flexion of about 50 degrees.

From the results obtained I believe we are justified in subscribing to the conclusions proposed by Tavernier 2 years ago at the third meeting of the French orthopedic society when he stated that he considered that for the knee arthroplasty was indicated not alone

[1] Société de Chirurgie de Lyon, 1921, March 10, Lyon chir., 1921, p. 547.

[2] Société de Chirurgie de Lyon, 1923, Jan. 11.

in the presence of vicious ankylosis, all types of which require operation, but was also indicated in the presence of ankylosis with the limb in a straight extended position when the accessory conditions are favorable.

Resection should be reserved for those cases for which arthroplasty is contra-indicated on account of the nature and the position of the ankylosis and the condition of the musculature and coverings about the joint.

TIBIOTARSAL ANKYLOSIS

We shall be very brief in this last chapter. We may have no exact idea what arthroplasty will accomplish in a case of tibiotarsal ankylosis, as the number of cases actually published is small, but we have, on the other hand, a rather distinct opinion that a modeling resection of the ankle, which often means merely an astragalectomy, gives satisfactory results. The recent discussions of the Paris Surgical Society on the treatment of vicious callus at the ankle, the reports of Bérard and Wiart at the twenty-ninth French Congress of Surgery have shown that astragalectomy is indicated in a good number of vicious ankyloses of the ankle; the operation frequently not only gives an opportunity to straighten up the foot and give the joint proper orientation but also results in movements which though limited in range are none the less useful. Astragalectomy is not always the easiest thing to do in such a case. One great danger arises when the bone is fused with the bones of the leg over a wide area. The most frequent indication is the correction of the vicious position; the attempt at movement is only secondary. Ollier has already advised that in such a case removal of the astragalus *in situ* by a modeling resection and chipping away with a chisel should take the place of the old cuneiform excision because the ideal operation in a case of this kind is one which aims at reconstructing if possible an ankle mortise which guarantees stability for any result obtained.

For the ankle, as for all other joints studied, the postoperative care is as important as the operation itself.

We wish to reiterate that in ankylosis of the ankle our aim should be first of all to secure a solid and well oriented joint. Prolonged immobilization must then be the rule when lateral and anteroposterior fixation is to be secured; then only intervenes the possibility of movements of flexion and extension which are quite frequently very satisfactory.

We shall not discuss the simple cases where the tibiotarsal ankylosis has not altered the form and the mutual relations of the bones, as in such cases astragalectomy is customarily indicated, and the results obtained justify its use.

CONCLUSIONS

The following conclusions may be made from this study:

Arthroplasty enlarges considerably the field of operation for ankylosis. In the hip and knee arthroplasty opens up almost a virgin field in joint surgery.

Resection for ankylosis becomes a secondary method to be used only after failures by arthroplasty or in those cases in which the condition of the bones of the joint, or more rarely the condition of the soft parts, makes mobilization a hopeless procedure.

SEROTHERAPY AND VACCINOTHERAPY IN SURGICAL INFECTIONS[1]

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TO treat in its entirety the question of serotherapy and vaccinotherapy in surgical infections would greatly exceed the time allotted me. The subject itself urges me to confine my discussion to very general ideas. The particular applications of most of the serums and vaccines have already been presented at various congresses for general or special surgery, but it remains the duty of each of us to report the results of our own personal experience. To try to conceal from oneself the facts that the study of vaccines and serums, which is in reality the study of immunity and immunization, bristles with difficulties, that it is still shrouded in mystery, and that it cannot be undertaken with too great circumspection would be useless, for the risk is great that the truths of today will not be the truths of tomorrow. It is for these reasons that I believe it will be best to forego the analysis of particular cases. Such analysis might increase the already existing confusion and thus lay myself open to most humiliating contradictions by future surgeons. I shall therefore present first a methodical study of the sum total of our present knowledge, and then endeavor:

To define with the prudence demanded in such cases, the ground already acquired;

To determine the rôle which serotherapy and vaccinotherapy appear to hold in relation to surgery and the degree in which they appear susceptible of modifying the surgeon's acts;

To form an estimate of what one may expect from these methods in the future, which in the end means the establishing of a program of association between biology and surgery.

The General Action of Serums and Vaccines—Paraspecific Action colloidal shock (widal)—peptonic action (nolf)

At the foundation of the therapeutic use of serums and vaccines lies the idea of specificity. Nevertheless, for many years none of those who have employed vaccinotherapy and serotherapy in human as well as in veterinary medicine, has failed to remark that these therapeutic measures have been successful in cases where the idea of specificity could in no way enter. What analogy is it possible to establish between two bodies as different *a priori* as a serum and a micro-organism except the analogy of their chemical constitution? Both are albuminoids, or, if one prefers, belong to the group of proteins. The fact is that it has been possible to influence the course of all sorts of infection by injecting into the organism any kind of protein whatever, milk or peptone, for example; in other words, in certain cases, vaccinotherapy and serotherapy are only forms of proteintherapy.

On the other hand, the physiologist Schmidt-Muehlheim long ago showed that the introduction of peptone into the veins produces certain effects which have been termed "peptonic shock." Many other experimenters have studied this phenomenon, and credit is due to Delezenne, in particular, for showing that a great number of other substances, such as microbic toxins, vegetable and animal poisons, and extracts of organs, are equally capable of producing as much shock as peptone. In fact one may affirm in principle that all substances possessing antigenic qualities, that is all foreign proteins in normal humoral medium, produce it. From the researches of Nolf it appears that a smaller dose eliminates the danger of peptonic shock—in its extreme form a brutal and injurious reaction, which follows the rapid introduction of too large a dose of peptone into the blood stream—and produces the "peptonic action"—the expression of a beneficial reaction. Such a dose is suitable for therapeutic use. The practical results obtained by Nolf with this method, particularly in the treatment of surgical septicæmias, are known. "But there is also a theoretical advantage gained by the

[1] Presented before the International Congress of Surgery, London, July 16-21, 1923.

introduction into therapeutics of intravenous injections of peptone. It has made us realize that, in the matters of serotherapy and vaccinotherapy, our ideas have been too simple, and that when we inject a serum or a vaccine into a patient the effect we obtain may be produced by other means than the specific antibodies which we introduce or cause to be formed. We now know that these agents produce, aside from their specific action, the peptonic action and that this is capable of curing even serious conditions." (P. Nolf.)

This is not the only idea on the subject to which the last few years has given birth. Since 1913, M. Widal and his pupils, P. Abrami and Étienne Brissaud, in a long series of reports have shown the importance of the colloidal reactions which may take place in plasma and which they term "*hæmoclasic crisis*," or "*colloidal shock*." In particular they believe that, in serotherapy and vaccinotherapy, certain immediate successes attributed to the specific action of the serums or vaccines are in reality caused by the reaction of protein shock which the presence of any foreign protein in the organism may produce. To sum up, it is not the substance injected which is the real curative agent, it is the shock provoked by the injection. So true is this that to complete the formula which we have given above, we must say: in certain cases, serotherapy and vaccinotherapy, like all protein therapies, are only forms of colloidal therapy.

THE THEORY OF SPECIFICITY

The work of these different men has broadened our ideas. It has drawn our attention to a series of phenomena the knowledge of which is of the greatest interest and utility. But it should not obscure for us the fact that the real importance of the idea of specificity must be grasped before we can hope to attain the true goal of serotherapy and vaccinotherapy, i.e., not to produce cures that can just as well be secured by other means, but to produce immunity. Immunity and specificity are inseparable terms, and to avoid the risk of serious miscalculations in the use of serotherapy and vaccinotherapy and to avoid failures in using these two methods, one cannot too often repeat that, in the present state of our knowledge, a real, durable immunity cannot be produced except by specific intervention. Specificity is the foundation of all our biological researches. I will cite a recent example. My preceptor and friend, Professor Vallée, with whom I have the very great privilege to work, has just introduced into the study of aphthous fever the idea of the plurality of viruses. How did he discover this and how could he demonstrate it? By the same series of classic experiments which have been used so many times by which it was possible to prove that by the side of typhus bacillus there were the paratyphus bacillus and by the side of the meningococcus the parameningococcus, etc.; that a patient who had suffered from a disease produced by a determined germ had in consequence resistance to that germ only, that preventive vaccination, like preventive serotherapy, conferred only a narrowly specific protection, and that it was, this peculiarity which was found at the starting point of the work of identification of the different viruses.

Further, M. Widal, having shown that to his mind the immediate effect of vaccines is explained not by a specific action, but by a colloidal shock, declares: "The employment of a specific vaccine has this undeniable advantage, that to the primary action, of which, as we have seen, the therapeutic effect is uncertain, there may be added a secondary action set up in the organism by the introduction of the antigen responsible for the disease." The same opinion is expressed by Nolf.

I believed it necessary to insist on these points. Because it has been demonstrated that serums and vaccines may have other than their specific actions, it might be concluded that it is no longer necessary always to pay so strict attention to the findings on which their employment rests. That unfortunate tendency has given rise to a great number of useless observations in the medical literature. Today, before we express our opinion on the treatment of cancer, we demand a detailed and competent histological examination; to form an opinion on the results produced by a given serum in a given disease, we must refer to the results of the bacteriological test.

The paraspecific use of serums and bacterial medicines none the less offers great conve-

niences to the surgeon. We are not acquainted with the germs of all diseases, either because they are as yet unknown, or because, as in certain walled-off infections, so frequent in surgery, they have escaped our investigations. We do not possess specific medication against all germs. In these circumstances serotherapy and vaccinotherapy, employed under the title of proteintherapy, render incontestible service, and it is with this consideration in view that M. Vallée and myself have been studying, since 1918, the microbic extracts to which we have given the general name "endococcine." These extracts appeared to us to possess the advantage over serums of not sensitizing the organism, and over vaccines of being products of more stable composition and of indefinite preservation, and over both of being more easily managed, since they possess a better titration and a composition always comparable to itself. In all cases where we possessed a specific medication we have found the employment of the endococcine useless or impossible. In this way we have obtained the most satisfactory results in a great number of infections differing widely as to seat and as to origin. These cases were presented in two reports, one to the Academie des Sciences on June 7, 1920, the other to the Société de Chirurgie de Paris, May 10, 1921.

Passive Immunization, Serotherapy

Serotherapy rests upon the demonstrated fact that by injecting into a patient the blood serum of another patient, naturally or artificially immunized against a disease, one transmits to the former the immunity enjoyed by the latter. The former receives the antibodies necessary for its defense which have been elaborated by another organism. It has had no share in the effort to produce them. Otherwise expressed, it accepts passively the immunity given it by another. The usefulness and indications of serotherapy may very nearly be deduced from these principles.

A certain number of serums may be used by the surgeon. They are very unequal in value.

In addition to antitetanic serum, the study of which does not come within the limits of this report, the war of 1914–18 showed the importance of antigangrenous serums. Certain explanations are necessary concerning them, for their study constitutes one of the most complex chapters in serotherapy, and one could not choose a better example to demonstrate the value of using strict scientific methods to get the greatest benefit from a wonderful therapeutic measure. It cannot be said that antigangrenous serotherapy always has been employed with understanding. It must be remembered, when one speaks of gangrene, or of gas gangrene, one means a symptom only, a symptom which is common to many diseases and very different germs. There is not one gangrene, but many gangrenes. It is impossible to differentiate them clinically, and when the symptomatic picture is complete, local phenomena (necrosis of the tissues, production of gas) and general phenomena due to poisoning of the central nervous system by the toxins generated by the microbes are present. Three principal germs were isolated from war wounds: the bacillus perfringens, the septic vibrio, and the bacillus œdematis described by Weinberg, which appears to be the germ described by Sacquépée under the name bacillus bellonensis. Each of these three germs may be found alone in the wound, or they may co-exist. They are frequently associated with other germs, the common pyogenic germs, in particular the streptococcus, which encourage their pathogenic activity. I have often seen the streptococcus, especially in its anaerobic variety, existing alone in a wound causing necrosis with local gas production and general toxæmia.

Serums have been prepared with all these different germs. Each is capable of acting efficaciously against the corresponding germ and against that one only. How is one to select the proper serum? We know with what rapidity gas gangrene septicæmia may develop from certain wounds. Haste is therefore necessary in the endeavor to prevent its appearance. To inject one only of these serums may prove of no use at all. To inject them all is a complicated procedure and makes it necessary to give a wholly disproportionate dose. The true solution has been found by Leclainche and Vallée, who, in producing their polyvalent serum are the actual

initiators of antigangrene therapy. It is curious to note that this perfect solution is the first in point of time, it was Leclainche and Vallée who inspired me to use a serum valent for all the pyogenic organisms and the perfringens and septic vibrio, which I did from November, 1914, on. One copious injection, made as soon as possible after infection of the wound and renewed at intervals as necessary, assures protection not only against the germs productive of gangrenous septicæmia, but also against the associated germs which are of such great importance. Have we not seen wounded succumb to streptococcæmia, who, thanks to a serum, had escaped the grave dangers of gangrene? For the surgeon this serum represents the ideal product, which does away with tentative measures and gives him a quasi-certainty that it will meet the situation. In medicine is one not guided by analogous principles in cerebrospinal meningitis? The first antimeningococcic injection is made with the trivalent serum, the necessity of which has been proved by recent researches. Later, when the causal germ has been identified in the laboratory, a less general, more directly specific, serotherapy can be used.

Their serum presented such simplicity of application that we regret that Leclainche and Vallée have now restricted its action to combatting the pyogenic organisms only. The Pasteur Institute of Paris furnishes excellent serums, directed, respectively, against the bacillus perfringens, the septic vibrio, and the bacillus œdematis. But I know, from having heard it so many times on occasions when my advice has been sought, that, confronted with this multiplicity of serums, the practitioner finds himself in a cruel embarrassment, not knowing to which he should have recourse. One can only reply as follows:

Numerous failures of antigangrenous serotherapy are explainable on the ground that the serum appropriate to the case was not used. They are again explainable by the fact that beside the gangrenous septicæmias that have their origin in the wounds, there exist other phenomena, also termed gangrenous, which have no causal analogy to the preceding.

It is thus, for example, that the terms pulmonary gangrene and appendicular gangrene give rise in many minds to the idea that the same germs that cause gangrene in wounds are responsible for these two processes. But, save in rare exceptions, they are not. Most often these diseases are produced by very numerous anaerobic germs living nearly always in symbiosis, which have been particularly well studied by Veillon, Zuber, and Guillemot, germs against which, unhappily, attempts to prepare an active serum have to the present time remained unfruitful. This has not hindered a large number of investigators from attempting to combat these infections by antigangrenous serums commonly in use, by means of general injections, or, in case of pulmonary gangrene, by tracheal injections. The results have been variable. Successes have been observed that cannot be explained except by the paraspecific properties of the serums employed, and failures that were due only to the absence of specificity. This brings us back to the statement that serotherapy must be guided by a rigorous bacteriologic control, and that, to demonstrate this anew, one could not choose a more complete and instructive example than that of antigangrenous serotherapy. It is for this reason that we have lingered a little upon it, but also because of its practical importance, which, for surgery, remains in time of peace very much what it was in time of war.

There are still other serums which present themselves to the attention of the surgeon. I do not speak of the antistaphylococcic serotherapy, which, used alone, is not adapted to frequent applications. Antistreptococcic serotherapy, in spite of all the disappointments it has caused, is of much greater value. It is possible that a part of the inconstancy of the results which it has shown may be due to defects in the technique of its preparation. Investigators are now striving for improvements in this particular. One of the most powerful antistreptococcic serums is that of Leclainche and Vallée, which possesses, among other things, the advantage of being polyvalent and attacking all the pyogenic micro-organisms.

Since 1897 endeavors have been made, with variable success, to prepare a good antigonococcic serum. In France, since 1913, Debré and Paraf have attempted to solve this prob-

lem. At the present time these authors, whose studies were interrupted by the war, employ the serum prepared by the Pasteur Institute of Paris by Professor Maurice Nicolle, the use of which is very widespread.

Finally one must not forget the antituberculous serums, the best known of which, in France, are those of Vallée and of Jousset. The latter is at the present time the only serum with which one can experiment practically, M. Vallée having, provisionally at least, given up his researches on this point.

In the present state of things, what success may one look for in practice from the use of these different serums? Results are unavoidably very inconstant. The reason lies in the very nature of serotherapy and in the inherent difficulties attending the preparation of a good serum.

By the introduction of the fully prepared antibodies, the serum injection aids the organism in its struggle against the infection. But it is necessary that the organism possess a minimum of the resistance required to profit by the reinforcement brought to it; in other words, that it should not content itself with the passive immunity conferred upon it by the serum, but should make active efforts to establish its own protection.

It is necessary to note also that the antistreptococcic, antituberculous, and antigonococcic serotherapy are directed against germs of a particular resistance. One may form some idea of the magnitude of the task which we demand of the different serums, when we consider the means of defense at the disposition of the microbes they must attack, which permits these to live, without becoming absorbed, in the interior of the leucocytes, the digestive action of which they succeed in escaping.

If we take for example the gonococcus, we may be met by an objection which Bordet, in his treatise on immunity, has taken pains to formulate: "One has attempted to apply serotherapy to diverse diseases to which our species is liable, and the results have been very unequal. One is often astonished, in the course of similar attempts, at the inefficacy of certain serums which nevertheless have proved themselves distinctly preventive, or even visibly curative, when administered to animals which, by inoculation with the variety under consideration, have developed one of these artificial diseases, one of these laboratory infections, such as typhus septicæmia." One has then the right to inquire what may be the value of these serums, produced by laboratory infections, on animals less sensitive.

One can even conceive, on the other hand, that it may be difficult to confer a passive immunity in those diseases that do not permit of an active immunity, which is unhappily the case with the streptococcus and gonococcus infections, tuberculosis, and syphilis.[1]

Finally, account must be taken of the fact that the principles contained in the serum afford us a very incomplete view into all that is necessary for the protection of the organism. With special reference to tuberculosis, note the following which was written by Calmette in his splendid treatise on bacillary infection and tuberculosis (*Traité de l'Infection bacillaire et la Tuberculose*): "It is generally admitted that there exists a sort of parallelism between the richness in antibodies of an animal serum or a tuberculous patient, and the activity of the means of defense of the same against bacillary infection. It would seem that this hypothesis is not strictly correct, for it frequently occurs that the development of the lesions continues even where the antibodies are very abundant. The fact that these disappear toward the end of the disease and that most often their rate increases in proportion to the intensity of the efforts of the organism in its struggle indicates that they appear rather as witnesses of cellular reactions against the infection. But that is sufficient to justify their investigation and incite us to the discovery of the proper means of augmenting their production." (p. 548.)

M. Calmette again writes: "In endeavoring to treat diseases by the injection of serum more or less rich in antibodies, agglutinins, precipitins, etc., we are probably making absolutely vain efforts; for as rich as the best serums known today may be in these various substances, in the doses in which they are in-

[1] It must, however, be observed that, as concerns tuberculosis and syphilis, the idea of the non-existence of an active immunity does not imply a total failure of the organic defenses. In these two diseases, in fact, we may note the insussceptibility to reinfection, which disappears, as in the case of syphilis, when the disease is cured.

jected, they add almost nothing to the quantities, normally considerable, of antibodies, agglutinins, etc., that are contained in the blood of the patients themselves." (p. 565.)

Still other reasons tend to limit the value of these injections of therapeutic serums. When a serum is introduced subcutaneously, which is the most common because the easiest and least dangerous manner, it should be noted that a certain quantity of useful antibodies is retained at the point of inoculation by virtue of that principle demonstrated by Vallée and Finzi, which may be termed "local fixation of the antibodies." Inspired by the work of Vallée and Finzi I brought to the notice of the Surgical Society in 1917 the importance of this idea to the surgeon. It was my habit to make interstitial injections of antigangrenous serum in the immediate vicinity of war wounds, with the object of uniting the general and local effects of serotherapy.

It is, on the other hand, thoroughly demonstrated, that a serum introduced into the general circulation can only with great difficulty reach certain fluids, such as the aqueous humor and the cerebrospinal fluid. The same may be said of the pathological fluids which are produced, in the case of infections, in the synovial membranes of joints.

LOCAL SEROTHERAPY

All these facts would be, to speak truly, discouraging enough, were it not possible to extract from them practical conclusions for the surgeon. Many of the infections which surgery has to combat are, if not local infections, at least infections with localizations. Since serotherapy for the moment is dashing itself against impossibilities and thus detracting from its success, would it not be possible to concentrate its undeniable benefits on those points where its necessity has been felt? In fact, the serums which, introduced into the general circulation, yield inconstant or doubtful results, may in local applications give a large proportion of successes.

Such is the basis of local serotherapy. Denys and Leclef have shown that leucocytes isolated from the blood of an animal vaccinated against the streptococcus do not seize upon the microbe with more avidity than leucocytes from an animal not so treated. But whatever may be the source of the leucocytes, the addition of an immune serum re-enforces in the same measure the phagocytic activity which is but feebly increased in the presence of a normal serum. On the other hand, it is easy to demonstrate experimentally that the serum does not act on the cell to make it a more powerful phagocyte but upon the microbe to make it a less rebellious prey. How does the presence of the serum render the microbe more vulnerable? The microbe becomes coated over, as with a dye, with the substances which favor its destruction. It charges itself with the very ferments of immunity. It absorbs the sensitizer. I would insist upon this point. The characteristic is not that the germ can be more or less readily phagocytosed but that it succumbs to intracellular digestion, in a word that it is destroyed. Many substances favor the phagocytosis. The antibodies alone permit it to be completed by intracellular digestion, which represents organic defense carried to its maximum of efficacy.

One cannot too forcibly call attention to the importance of the local application of serum. Up to the present time we have been almost too exclusively devoted to general effects, specific or otherwise. Thus we have not obtained from serotherapy all the benefits it is possible to obtain with it. I repeat that a serum which gives negative results when introduced into the general circulation has a local effect, produced by the antibodies which it contains and which by elective action fasten upon the germs rendering them vulnerable. There will not be found a better example than that of the antirabic serum, which has no curative or preventive power but which, brought into the presence of the virus, entirely neutralizes it.

Different applications of local serotherapy have sprung from these principles, still too little known. In 1912 Leclainche and Vallée recommended specific serum treatment of wounds by means of their polyvalent serum. I had the honor to be associated with them in their clinical investigation from the beginning, and their method, which I had very extensive opportunity to employ during the war, gave

me, as it did all other surgeons who used it, incontestable successes.

In 1919 Debré and Paraf described the treatment of gonorrhœal rheumatism by local injections of antigonococcic serum. Paraf in his thesis (Antigonococcic Serotherapy, Paris, 1919) reports 16 cases treated, with 14 complete cures obtained. I myself discussed this interesting method of treatment before the Surgical Society of Paris (March 16, 1921, p. 390), and later other conclusive cases were reported before the same society, notably by Mm. Auvray and Michon. Personally I have applied local intra-articular serotherapy to certain forms of tuberculous synovitis known under the name of tuberculous hydrops. I have cured several patients of that affection. One of them was brought before the Surgical Society on January 25, 1922 (p. 116). The antituberculous serum which I used in all these cases was furnished by M. Vallée. M. Jousset told me that he also tried this treatment on one occasion, but with a serum that he had himself prepared. In a bacillary hydarthrosis that had been treated by means of several punctures which were followed by immediate relapses, Jousset did one injection of this serum with the result that in a few days the hydarthrosis had dried up, not, however, without there having taken place a violent reaction lasting 36 hours.

I also had occasion in the course of the war to practice intraspinal injections of Leclainche and Vallée's polyvalent serum for traumatic meningitis. Philibert obtained cures in three cases of suppurative streptococcic meningitis by injecting antistreptococcic serum into the spinal canal.

Local applications of serotherapy are thus seen to possess for the surgeon the highest possible importance. Instead of taking up the ofttimes illusory research into general effects, he should direct his efforts toward the utilization of the local neutralizing properties of serums.

ADVANTAGES AND DISADVANTAGES OF SEROTHERAPY

Specific serotherapy in producing in the organism a passive immunity possesses the double advantage of acting very rapidly and of demanding no effort on the part of the organism. For this reason it is valuable. It is the heroic remedy, the remedy for critical cases.

On the other hand, these advantages are compensated for by a certain number of disadvantages. In human medicine the serums are all derived from the horse. The serous albumin which serves as support and carrier of the antibodies belongs to a foreign species and hence tends to be quickly eliminated by the emunctories of the organism, taking the antibodies with it. In order that the value of the passive immunization conferred by the serum shall not fall too rapidly, it is necessary, where a durable immunity is desired, to renew the injections. Now what is the effect of repeated doses?

a. An organic defense exerted against the foreign albumin of the serum and at the same time against the antibodies which it contains. The action against the foreign albumin produces the general serous symptoms, and they are too well known to need mention here, and the symptoms of local intolerance in the presence of serums, which is less often spoken of but of which it is important to be warned. Everyone knows that in cerebrospinal meningitis the intolerance of the meninges to serous injections often impedes the continuance of the treatment, or in any case indicates that it should be stopped. I have myself observed serous arthritis secondary to intra-articular injections of serum, and have drawn the attention of surgeons to it, and to the necessity, in certain cases where it is found, of not overprolonging the specific serous treatment of wounds, which at a certain point, may become more injurious than helpful.

Bordet has shown that there is also a reaction against the antibodies, and he has made us acquainted with anti-alexins, anti-agglutinins, anti-sensitizers. Other authors (Dehne and Hamburger, Gay, Vallée and Finzi) have disclosed the existence of an anti-antitoxic function. All these discoveries point to the fact that at each fresh injection the serum is less and less utilized and its action is less and less certain.

b. If the human organism defends itself against the different elements carried by the

serum, the germ of the disease, itself a living entity, if it has not succumbed at first, prepares, on its side, a system of resistance. In experimenting on the streptococcus, Bordet has been able to prove that certain microorganisms, engulfed by the leucocytes, have been enabled to escape from the destructive influences that attacked them, "they awaken, multiply, and give birth to entities endowed with very pronounced virulent qualities of normal appearance and dimensions, but surrounded by a strong protective capsule." That sheath, that areola which protects the streptococcus, is transmitted to its progeny.

FAILURES OF SEROTHERAPY

We have enumerated all these experimental facts only because they make it possible for us to understand the failures of serotherapy and consequently to endeavor as far as possible to avoid them.

A serum may give no result—

1. Because one has chosen a serum that is non-specific, the serum may be prepared for a germ of another species; or if for one of the same species the important principle of the plurality of races, each possessing its own specificity, has been misunderstood.

2. Because one has given too weak a dose. It may be supposed that when the serum spreads throughout the organism it undergoes great dilution which brings about a lowering of concentration of the active substances which it contains and in consequence a great diminution in their activity, which might extend to their annulment.

3. Because action was too long delayed. From numerous experiments with all sorts of germs and serums, it has been shown that the protection offered by these latter increases in inverse proportion to the time that elapses between the entrance of the virus into the organism and the introduction of the serum into the organism. Practically this is all that constitutes the superiority of preventive serotherapy over curative serotherapy.

4. Because one has selected a wrong route by which to introduce the serum. We have just shown that a serum introduced into the circulation reaches certain organs in negligible quantities. It is, therefore, illogical to treat local infections of these organs by general injections of serum, which in such cases are of no advantage except as an adjuvant of the local serotherapy to combat general symptoms, to prevent other localizations and above all to arrest the too rapid elimination of the serum deposited *in situ*.

As for general serotherapy, all the authors (S. Arloing, Calmette, Salimbeni, Vaillard, and Dopter) are agreed in attributing great importance to the route by which the serum is introduced. By means of tuberculous serum endowed with precipitation properties in the presence of tuberculin, Vallée and Finzi have proved that—

1. During the first few hours after the injection of serum, the recovered serums which were richest in antibodies were those of the animals treated by the venous route; there follow, in order of decreasing activity, those of the animals treated by the peritoneal route and rabbits injected subcutaneously.

These differences registered in the precipitation value of the serums recovered from the various animals may also be set down in figures. The serum of rabbits treated by the venous route precipitates at the rate of 1 to 100 (1 of serum to 99 of antigen), that of animals injected by the serous route furnish a precipitate equal only to 1 to 50 and that of rabbits treated hypodermically yield the equivalent of 1 to 10.

2. "Examining next the fate of antibodies introduced by the different routes, and the progress of their elimination by the organism, we found that at the end of 21 days the precipitation value of the serum of rabbits treated by one or the other method has become the same, and that on the twenty-seventh day of the experiment the serum of the rabbits treated by the various routes has lost all its activity, while those animals which received their serum at the same time as these, either by the peritoneum or subcutaneously, were still distinctly precipitating demonstrable antigens. The precipitating aptitude of the serum of rabbits injected into the peritoneum ceased to be discernible after 28 to 32 days; that of animals injected subcutaneously preserved precipitating qualities 32 to 38 days according to the weight of the rabbits.

PRACTICAL CONCLUSIONS

From all that we have been explaining it follows that to derive from serotherapy its maximum of efficacy it is necessary:

To act early. An antitoxic serum has no action upon toxins lodged in the nervous centers.

To administer strong doses from the first. This is the best means of strangling an infection and of avoiding those curious cases of microbic adaptation by which a patient attacked by streptococcic septicæmia may, thanks to the serum, and contrary to all expectations, escape the immediate death that menaced him, but in the end succumb to multiple localizations.

To repeat the injections, when a durable immunity is required.

To give the serum locally whenever possible.

To use the venous route when quick action is important, which is the case in curative serotherapy.

To have recourse to the intramuscular or subcutaneous route if it is necessary to obtain prolonged action by the *preventive serotherapies.*

That serotherapy should not be used:

1. In chronic diseases, except to suppress a threatened acute attack or where a rapid local result may be hoped for. This is the case in antituberculous serotherapy.

2. Or in diseases in which the danger may increase slowly; for this reason M. Vallée and I substituted antitetanic vaccination for serotherapy in those patients whose wounds healed slowly, or who still retained foreign bodies which had been impossible to extract.

That a serum should be regarded as a remedy to be used only in critical conditions and never without careful consideration. M. Marfan has protested against the abuse of serums used without discrimination for the treatment of hæmorrhages, acute non-diphtheritic tonsillitis, erysipelas, anæmia, pneumonia, etc. "The therapeutic results of such employment seem hardly favorable. It would be better to refrain from using them so that the patient will not be in a state of anaphylaxis, that is to say, in a state of lowered resistance at a time when he shall have real need of specific serotherapy." Bordet also has declared: "In human therapeutics it is wiser to abstain from using, at least as a routine measure, those injections of a horse serum sometimes recommended for the treatment of morbid conditions of little danger, so that if the organism is attacked by some grave disorder, such as diphtheria which is amenable to serotherapy, it will not find itself prepared to combat the valuable antibodies elaborated by the horse."

We ought to be much more concerned about the existence of an antiserum function in persons who have previously received injections of serum, than about the dangers of anaphylaxis. To speak truly, these dangers are very rare, and there are many effective and simple means of avoiding them, whereas we can do nothing against the formation of antiserums which are certain to result in imperfect utilization, or no utilization at all, of a serum injected later.

Consequently, in all cases where they are not strictly useful, serums should not be used. This applies particularly to all cases where it is possible to use instead active immunization by means of vaccination.

ACTIVE IMMUNIZATION—VACCINATION

"To put the organism artificially in a state comparable to that in which it would be if it were cured of a spontaneous attack of a disease under consideration is the object of active immunization or vaccination." (Bordet.)

It will be seen that this definition implies the idea of specificity. We shall not speak further of the paraspecific effects of the vaccines which we studied in the beginning and which are common to all other products as well as the microbic. Here it will, perhaps, be well to settle the terminology. The use of vaccines, without taking account of their specific properties is, properly speaking, bacteriotherapy. When they are employed to bring about specific actions, they may be used preventatively, to preserve the organism from the attack of a disease, in which case we speak of vaccination. Or, again, the vaccine may be used to cure an infection in the state of development, and the term then applied is vaccinotherapy by which is indicated a specific bacteriotherapy.

In surgery, however, one very seldom has occasion to use true vaccination. The infection has usually declared itself. But it is important to explain that, since the surgical infections which are most amenable to treatment by vaccines are either diseases that evince a great tendency to relapse, such as streptococcic infection, or those, such as inflammations of the urinary passage, which are produced by germs usually saprophytes, that have become pathogenic, the administration of a vaccine has in reality the double object of curing the disease in its course and of preventing relapses or the return of the saprophyte to the pathogenic state. Thus the surgeon in his ordinary practice simultaneously obtains from vaccinotherapy and vaccination, prophylaxis and a cure.

JUSTIFICATION OF INJECTIONS OF VACCINE

One may inquire the basis upon which rests the injection of microbic bodies in an existing infection. It may seem strange that the organism in which the living germs are developing, which represents *a priori* the best antigen, and which, nevertheless, has not succeeded in immunizing itself, can be benefited by introducing dead microbes. But justification of method will be seen if it is recalled that—

1. A local infection confers no general immunity. "The germs which vegetate in circumscribed areas of the organism and maintain their hold there with tenacity, though in limited numbers, do not come into sufficiently extended contact with the agents of defense. Phagocytosis especially does not exert its influence widely enough, hence absorption is not sufficiently elicited." (Bordet). They produce the phenomena of local immunity but not of general immunity.

2. The germs prepared for use in vaccines are more easily reached by the agents of defense than are those which have multiplied in the tissues. A germ which is not absorbed cannot excite the formation of antibodies. The tendency shown by certain surgical infections to become chronic and to recur is due to persistence of microbes, which have not been digested by the cells. It is for these diseases that an endeavor should be made to obtain efficacious vaccines.

At present the list of vaccines that have stood the test of experience and give sufficiently constant results is not long. The good vaccines employed in surgery are only two: (1) staphylococcus vaccine, which is intended for all staphylococcic infections, furuncles, anthrax, abscess of breast, and acute and chronic osteomyelitis; (2) vaccine for urinary infections produced, especially, by the colon bacillus, alone or associated with the enterococcus, micrococcus tetragenus, etc. Other vaccines have been proposed.

The streptococcus and gonococcus vaccines have given less conclusive results than have the two mentioned.

Various vaccines for tuberculosis are also being studied. M. Jousset employs an avirulent, soluble product, an extract of highly toxogenous bacilli. At the price of very strong but temporary reactions he has obtained some beautiful results in adenopathic fistulæ, cutaneous gummata, visceral suppurations, such as infections of the prostate and adnexa, and especially in those cases in which there is as yet no necrosis of the tissues but only an inflammatory hypertrophy, as in many of the tuberculous adenitides. Judgment cannot yet be passed on these results which represent only attempts. I have cured fistulæ following tuberculous lesions by attacking only the germs of the secondary affection, and, on using "endococcine." I have in a like manner seen ganglionic lesions recede. The work of M. Jousset who carries such scientific precision into all he does, should be followed with attention.

GENERAL INDICATIONS FOR VACCINES

From what we now know it would seem that vaccines have a double action—

A primary action, almost immediate (colloidal shock, peptonic action) due to their physicochemical constitution;

A secondary, truly vaccine action which demands that the natural defensive reactions of the organism be brought into play and consequently requires a certain amount of time for its manifestation.

It is, therefore, logical to apply vaccination only to those infections which are acute and present but moderate tendency to becoming

generalized. The fact that vaccination, contrary to serotherapy, demands an effort of the organism might give rise to the fear that while the organism was drawing on its energy to absorb the vaccine, the germs of the infection would profit by the diversion thus created to extend their activities. Wright has shown that every vaccination commences by creating what he terms the "negative phase." The reality of this negative phase has been doubted. Numerous experiments, however, as also clinical observations, in human as well as in veterinary medicine, tend to demonstrate it. I believe that until we have more information it will be prudent to take it into account.

It would be better to abstain from throwing too great a burden on the patient with severe infection, who, as it is, has difficulty in keeping up the struggle. In grave, acute infections, serotherapy is more suitable. We will return to this point later.

On the other hand, should vaccination be employed in infections that have passed into the chronic stage? In regard to osteomyelitis certain authors have replied categorically in the negative. If they mean that surgical treatment alone can cure a central bone abscess or remove sequestra, I agree with them. But I must say that in many cases where the roentgen picture reveals no localized lesion upon which to operate, where the disease manifests itself only by pain and fugitive inflammatory symptoms and disappears spontaneously after a greater or less lapse of time, resting latent over a variable period, then suddenly announcing itself in fresh attacks, I find myself much inclined to vaccinate repeatedly at regular intervals. It seems possible by this means to keep imperfectly extinguished foci in a torpid condition and avoid their flaring up. It is possible that in the end they would be entirely sterilized. Be that as it may, in the case of a woman previously operated on for osteomyelitis of the tibia, who had an abscess of the calf of the leg the size of a fist, I saw the abscess, which at the beginning of treatment contained a great number of staphylococci, both albus and aureus, become progressively aseptic under vaccine treatment, and as, at the same time, it had become surrounded by a thick fibrous capsule, I was able to remove it like a cyst and obtain closure of the wound by primary intention.

Another proof of the importance of vaccination in chronic cases is furnished by the study of gonococcic infection. It is generally admitted that gonococcus vaccination fails to influence acute cases except in a very uncertain manner. On the contrary it is often decidedly efficacious against the sequelæ of the infection. I have seen it succeed in prostatic infections that were resistant to local treatment, however well carried out.

The mechanism of the action of the vaccine in such cases has not been completely elucidated. But should we not here recall how Wright understood the action of vaccination? "Therapeutic immunization is theoretically admissible so long as there remains in the body a part that does not give its maximum reaction to the immunization; and the program of therapeutic inoculation would consist naturally in exploiting, in the interests of the infected parts of the body, the immunizing reactions of the parts not infected."

This is why it seems to me that vaccination may render good service in osteomyelitis or gonorrhœa, diseases which, passing into a chronic state, cease to be general and become purely local.

VACCINE REACTIONS

The introduction of a vaccine into the organism elicits local and general reactions.

A. *Local reactions.* (a) *On the lesion.—Focal flare-up.* One of the first effects of vaccines in most cases is that they appear to produce an aggravation of the symptoms. The flare-up of the focus shows that there exists a negative phase, during which the germs possess an increased virulence. But it must be remembered that the turgescence of the local lesions and the increase of purulent discharges are due, besides, to a very salutary excitation of leucocytic action. The focal reaction may also be compared with what takes place in preexistent foci when the "phenomenon of Koch" is produced at the point of reinjection. The vaccine, as in tuberculosis, produces a truly expulsive phenomenon, manifested, when there exist merely congestive lesions, by the rapid disappearance of the locally amassed

germs, or, when there is already suppuration, by a more rapid disappearance of necrotic lesions.

(b) *At the point of inoculation.* The introduction of the vaccine frequently produces a reaction at the point of inoculation which appears as a bright red plaque, the skin being tense, hot and painful. This temporary reaction may be accompanied by an inflammation of the lymphatic glands and vessels.

In many patients an analogous, but less acute, reaction is produced, not at the site of the last injection but at that of a previous injection. I have often observed this phenomenon with which others, familiar to experimenters, may be compared. Thus for example, when epizootic lymphangitis of the horse is reproduced, the creation of a fresh lesion starts up a new life in the foci previously created. Thus again the oculo-reaction has been seen to revive on subcutaneous injection of tuberculin.

GENERAL REACTIONS

Often very violent general reactions accompanied by malaise, rigors, and high septic temperature variations are observed.

It has been asked if these reactions could not serve a diagnostic end. But the results obtained have been discordant and absolutely inconstant. I do not believe that vaccine reactions can, at the present time, serve as evidence to the presence of the germ. They reveal only the sensitiveness of the organism to a given germ. From this point of view alone they may, as we shall see, render valuable service to the surgeon. One fact is very striking. Speaking of the use of Delbet's vaccine, M. Ombredanne pointed out that the reaction following injection of vaccine often fails to appear in children, whereas in adults it is the rule. I believe this difference can be explained on the ground that the pathological past of children is far less heavily charged than that of adults, and that they have not yet been submitted to all those influences that modify humoral equilibrium and the harmony of the means of natural defense. This opinion seems to me to be in accord with what we have learned of the reactions to tuberculin and, more recently, to diphtheritic toxin.

RESULTS OF VACCINATION

In fortunate cases, vaccination produces modifications in both the local and general conditions. It would seem useless to dwell upon these cures. But the manner in which they take place is important in order to judge of the value of the method.

When the lesions are local so that their development can be kept under constant observation, as is the case with furuncles, for example, one is struck by the fact that, in serious, rebellious forms, the disease does not disappear all at once. The present attack recedes, in general, rapidly before the influence of the vaccine. But another attack may supervene even before the first is entirely cured. In this case its activity is seen to be less. The furuncular microbes are rarer and smaller. Many do not result in suppuration. Each fresh attack thus is less severe than the preceding one, and in this we recognize the primary effect of vaccination, swift but fleeting, which supresses the present attack without preserving from those that follow, and the secondary effect, which is slower and which demonstrates the progressive resistance of the organism to the infection.

In other cases where there is frank suppuration, a change may be effected in the contents of the abscess, so that it no longer presents a tendency to spread and may be cured by an incision. As I have said, it is possible to render an abscess completely sterile, and in cases yet more favorable, on which it would be rash to build, to obtain even an absorption of the pus.

At the same time the general condition is improved. It is remarkable with what rapidity this happy condition frequently supervenes, even before the lesions are sufficiently altered to explain it. One might say that the organism which hitherto had been held in subjection to the infection, had now gained the upper hand. Under certain circumstances improvement in the general condition is the real benefit to be obtained from vaccination. This is the case, for example, in many infections of the urinary tract. I am speaking of the frequent colon-bacillus infections. Some are acute in their course and, it must be recognized, can be completely cured without vaccination; the cure can be verified by the dis-

appearance of both pus and microbes. But in other forms, of slow course, an ideal cure is more difficult to obtain. The pus disappears but the microbes persist. This accords with the discovery that certain persons are carriers of bacteria and that their urine contains undoubted colon bacilli. The germs live as saprophytes, awaiting only the occasion to awaken and become pathogenic. What is the aim of vaccination? To cause the microbe which has become pathogenic to return to its former condition of saprophyte. When this has been attained, when an equilibrium in favor of the organism has been re-established, the general condition improves, although, properly speaking, the word "cure" cannot be used here, for the microbe is always there, ready to profit by the least weakening of the defenses. M. Vincent has shown that the urine of patients thus treated by vaccination contains few antibodies, and by this he explains the difficulty found in curing such cases, in the exact sense of the word. I believe, nevertheless, as I have just said, that vaccination is useful. We all know that urinary infections have, from time to time, febrile flare-ups in the course of which culture of the blood is often positive. A good work might be done by increasing the quantity of the circulating antibodies.

I have witnessed true "paradoxical vaccinations." A man with a large vesical calculus had a severe urinary infection. With a view to preparing him for the necessary operation the patient was vaccinated. The general condition improved, the urine was found to be sterile. In a very aged woman both kidneys were filled with calculi. Surgical intervention did not seem permissible, and yet at nearly regular intervals she underwent violent attacks of urinary fever. It was conjectured that the febrile crises coincided with the periods when the natural immunity, which she was able to acquire, fell. An attempt was made to reinforce immunity by auto-vaccination. The febrile attacks did not reappear, in spite of the presence of the calculi, although germs were always present in the urine. It would seem that vaccination permitted the organism to keep the infection within limits where it would not be troublesome, etc.

DURATION OF THE IMMUNITY CONFERRED BY VACCINATION, REALITY OF THIS IMMUNITY

As I have insisted so often that vaccines which are suitable for surgical infections in which the tendency to relapse is only too certain, and which, furthermore, confer upon the body no natural immunity, are not so much curative as preventive vaccines, I would like to be able to make some definite statement as to the duration of the immunity conferred by vaccination. However, in spite of the great practical importance of the question, I am unable to do so.

The microbes from which vaccines are usually prepared for surgical uses are not what would be called good antigens. It follows that the experimental study of the immunizing properties is very difficult and of scarcely as much use as a guide to treatment as was the case in serotherapy.

On the other hand, even though we have cured a surgical infection we cannot infer that it is because we have produced phenomena of immunization in the organism. We all know that furuncles, erysipelas, and gonorrhœa are cured spontaneously, and, alas, we know also that a first attack is no protection against subsequent ones.

In some very rebellious infections, certain furunculoses, for example, which continue without intermission and in spite of all treatment up to the day of vaccination, one sometimes sees a sort of truce take place. Inasmuch as it was preceded by the phenomena of steadily progressive attenuation which we have described, and as the cure took place after various other forms of treatment had failed, it may be adjudged that the credit is due to the vaccination; consequently, to an immunization. But in these cases I have seen a fresh attack occur after the lapse of about 3 months. In the cases to which I allude, they were, it is true, less severe than the first attacks and usually they yielded more readily to the fresh series of vaccine injections with which they were combated.

It will be concluded that the immunity conferred was very fragile, since we were obliged to renew it by *revaccination*. But it is clear that the new series of vaccine injections had a more rapid effect than the first. We know that

patients previously vaccinated retain for a long time after their immunity has considerable diminished an extraordinary aptitude to reproduce antibodies when they are again called for. If it is desired to obtain as complete resistance as possible in a case of stubborn infection, I think that rather than carry out one very long series of vaccine injections, it would be better to give several series with periods of rest between. It seems to me that I have obtained the best results in this way. This accords with a remark often heard in the institutes of serotherapy. It is not possible by increasing the dosage of the inoculations to produce through the horse a serum which exceeds a certain strength. If instead of rushing blindly on in an attempt to increase the immunity given to the animal, the treatment is suspended for a certain time, when it is begun again the strength of the serum is seen to rise suddenly.

We have seen that the immunity to surgical infections conferred on man is of short duration and that it is so fragile that, to be preserved, it must be continued and we ask ourselves: Do we vaccinate, in the sense of immunization? A partial immunity is perhaps conferred, but we are free to doubt whether it is total. Contrary to what we have noted in the case of serotherapy, vaccinotherapy is more successful in the cure than in the prevention of disease.

Our inability to give information on these fundamental points, *the duration of the immunity* and *the best means of obtaining it* (choice, dosage, routes for introduction of vaccines) is because of the fact that at the present time we possess, aside from Wright's opsonic index, which shows only one of the aspects of the problem, no practical means of controlling vaccinations.

FAILURES OF VACCINATION

We will attempt to determine some of the causes for the failure of vaccination:

a. *Those depending upon the organism of the patient.* Some persons have difficulty in acquiring immunity. They present what is termed anergy. This anergy may be natural or connected with a condition or a disease. There is an *anergy of pregnancy.* While vaccination succeeds wonderfully well in abscesses of the breast in women who are long past confinement, I have seen it fail or succeed with difficulty in pregnant women. Noël Fiessinger and Paul Brodin, in experiments with tuberculin, have demonstrated the anergy of persons suffering from diseases of the liver. The seriousness of operations on patients with hepatic infections is also recognized. As Bordet states: "Vaccinotherapy by stimulating the patient to develop the reaction, which the disease is itself exciting, may contribute to the cure, but in such a case it is merely reinforcing salutary processes already at work."

In other words the normal effort of the organism can be sustained and re-enforced. It cannot be created.

b. *Others depending on the nature of the germ.* We repeat, according to the definition which we gave: "The goal of vaccination is to put the organism in the condition in which it would be if it had contracted and recovered from a spontaneous attack of the disease under consideration"; therefore, the resistance conferred by the vaccine will be in direct proportion to that produced by the cure of the natural infection. Now none of the infections to which we apply surgical vaccinotherapy gives definite immunity.

c. *Still others depending on the choice of the vaccine and method of using it.* There can be no chance of setting up immunizing reactions unless the specific vaccine is used. Many failures are due to the non-observance of this fundamental principle. It was the need of assurance that one was making a specific attack on the causal germ in undetermined affections that led to the creation of polyvalent vaccines.

This is not all, since in surgical infections vaccination directed against germs which have had their abode in the organism for a certain length of time, it comes about that by a phenomenon of particular adaptation they take on special characteristics, which results in a new type of organism, and it is no longer enough that a vaccine be prepared from microbes of the same species—microbes of the same cultural characteristics must be used. It is this that makes *autovaccine* successful where stock vaccine has failed.

But there is still more. In a vaccinated patient who seemed to be making a definite recovery, I have sometimes seen a fresh local symptom start and develop as stubbornly as in a non-vaccinated patient. Since I believe that one cannot attach too much importance to the adaptation of the microbes which succeed in protecting themselves against the defenses of the organism while the latter is becoming immunized against them, I asked myself whether my autovaccine failed to act because a new type of organism of microbes had been formed. I prepared a fresh autovaccine and was, in fact, able to arrest again the development of the symptoms. From this I infer that although stock vaccines render valuable service because of the convenience they offer, cases will be found where strictly specific autovaccine becomes necessary, and where this will have to be adapted frequently, so that it may correspond to the adaptation of the germ combated.

It is certain that a vaccine may be more or less efficacious according to the manner in which it is prepared. The choice of culture medium and the process of attenuation of the germs are of undoubted importance. But this is the business of the bacteriologist rather than the surgeon. The ideal before us should evidently be to make the *living virus* of practical utility, as in veterinary medicine.

I have stated that unhappily empiricism hovers over the use of vaccines. It is only by tentative methods, by studying each particular case, that it can be decided what dosage should be employed and at what intervals the injections should be repeated. To be fruitful the practice of vaccination demands an untiring spirit of observation.

BY WHAT ROUTE SHOULD THE VACCINE BE ADMINISTERED?

Generally speaking, the subcutaneous route is adequate. It is the easiest and least troublesome, but it has the drawback that a great part of the vaccine is absorbed locally, creating a local immunity and thus lessening the general immunity which is sought. To insure obtaining the maximum effect the vaccine must be introduced directly into the circulation. The intravenous route permits the use of very much smaller doses. The technique is certainly more delicate.

Besredka urges that the result of the introduction of the vaccine should be the most perfect reproduction possible of the disease against which the vaccination is made. Thus the vaccine must take the same course through the organism and effect the same organ or group of organs as the virus itself. This is the price that must be paid if the syndrome created by the vaccine is to be a faithful tracing of the disease itself and the vaccine is to develop its maximum efficacy.

In the application of these principles Besredka recommends *buccal vaccination* in all infections of intestinal origin. I have tried to carry out the same idea in urinary infections by colon bacilli and usually treat these infections not alone by subcutaneous injections of vaccine but also by causing the patient to ingest a specially prepared vaccine. It has seemed to me that by such procedure I have obtained more satisfactory results.

On the other hand, I believe that the buccal route is insufficient to assure vaccination against those diseases that do not originate in the intestines. By virtue of the principle of local immunity, the vaccine introduced into the digestive tract uses up most of its power in the intestines. Numerous experiences have shown that, at least in certain diseases, the general protection given by the buccal vaccine was insufficient. I need not enumerate all the germs used in France for the preparation of vaccines, Delbet's, Le Moignic and Sézary's lipo-vaccines, Mauté's soda vaccines, etc.

It may be that new horizons are being revealed to us by the discovery of the phenomenon of d'Hérelle. Already Bordet and his assistants, Gratia and Jaumain, have made most interesting therapeutic attempts with the staphylococcus. But the staphylococcus frequently succumbs very easily. Bordet on one hand and Courcoux, Philibert, and Cordey on the other have taken up in the same way the treatment of urinary infections on the anti-colibacillary lytic principle.

These researches deserve to be followed with the most scrupulous attention, as they allow us to form some idea of what may be the future of vaccination.

PARTIAL FAILURES

Failure of the vaccination may be only partial. "It is important to take into account the fact that certain microbes, even if assisted by antibodies, do not allow themselves to become engulfed before they have submitted to the influence of the alterative principles of the leucocytes; the cure of the infection for which they are responsible, therefore, demands the previous formation of an exudate very rich in phagocytes, that is to say, the setting up of a very strong local immunity. In such a case, resistance requires a very definite inflammatory reaction. Hence one cannot speak of an absolute immunity. In other words, when confronted with such microbes (staphylococci, streptococci, etc.), general immunity is by itself not enough to assure *ipso facto* local immunity: an afflux of leucocytes, large enough to cause symptoms, may be accompanied by the appearance of a new lesion identical with the first." (Bordet.)

The results of vaccination cannot be properly appreciated without an understanding of these facts.

Mixed Immunization—Sero-Vaccination

If one tries to establish a parallel between the action of serums and that of vaccines, used specifically, one arrives at the following conclusions, briefly stated:

Serums bring to the organism antibodies ready for immediate use. Unfortunately, the foreign albumin of which they are composed is rapidly eliminated by the organism and the antibodies, which it serves to support, go with it. Thus the immunity conferred is but transitory.

Vaccines have for their object the production of an immunity which is more durable but which requires a certain length of time before its appearance, during which the organism may find itself temporarily in a state of lessened resistance (Wright's negative phase). Now, the subjects of surgical vaccination are already suffering from infection, and injection of microbic cultures, even attenuated, may prove no trivial matter to them.

Would it not, therefore, be advantageous to combine the good points of the two methods, eliminating their inconvenient features? This is the aim of the mixed immunization, active and passive together, of sero-vaccination.

Leclainche, a long time ago, first thought of employing a mixture of serum and vaccine in the treatment of animals; in this case it was used for wheal-worms in pigs, later Calmette and Salimbeni did the same in man for plague. But, unfortunately, this mixed method of sero-vaccination, which has yielded such wonderful results to Leclainche and Vallée in veterinary medicine, when used for certain carefully selected germs, is not applicable in all cases. Too often an excess of serum causes such a saturation of the vaccine that the latter loses its special properties, and the immunity conferred by the mixture of serum and vaccine is not more lasting than that which is given by serotherapy alone. Besredka has demonstrated, however, that it is possible, from cultures of microbes and the corresponding serum, to prepare certain vaccines possessing incontestable, rapid, and durable efficacy. These he calls "*sensitized vaccines*." The principles which underlie their preparation are, according to Besredka, the following:

"The addition of specific serums to the bodies of the microbes having been proved prejudicial to the duration of the immunity, we propose to use only the specific substances in the serums, eliminating the albuminoid and other matter which is abundantly present in the serums. In order to carry out this selection, it was clear that we could not do better than turn to the microbes against which the serums were directed. We know from the work of Ehrlich and Morgenroth that every cell, and particularly every microbe, placed in contact with the corresponding antibody, fixes upon the latter, to the exclusion of every other substance contained in the serum. Having seized the antibody, the microbes do not let go. They may be withdrawn from the serum which bathes them, they may be washed in physiological salt solution, but they will still remain impregnated by the anti-body. It is these microbes which have attracted to themselves the antibody of the serum, which are, so to say, tinged with what is called the amboceptor or specific sensitizer, which constitutes the sensitized vaccines."

This ingenious method of combining serotherapy and vaccination has been used by certain authors in the prophylaxis and treatment of the most diverse infections. I have myself made frequent use of sensitized vaccines in surgery with most encouraging results. Together with my friend Cuvillier, I have demonstrated the valuable aid to be received from Besredka's vaccine preparations, which may be expected from the polyvalent serums of Leclainche and Vallée, which permit the sensitization of all the most frequent pyogenic germs with which the surgeon has to contend.

I desired to describe Besredka's method in this report, because of its importance and practical convenience. If one uses a mixture of serum and virus, one runs the risk, if there is an excess of serum, of conferring on the organism a protection so great that it will not make the effort necessary to the production of active immunity, or, in case the saturation of the virus is insufficient, of favoring the development of symptoms against which one wished to fortify the organism. Sensitized vaccines aim precisely at avoiding this twofold danger.

But this is not their only advantage. In the preparation of the vaccines in general use in human medicine, the microbic cultures are supposed to be treated by physical and chemical agents which dilute them to a greater or less degree. In Besredka's method, on the contrary, the germ is merely passed through the serum, and is inoculated, as one may say, alive. I myself have never yet dared to conform to this practice and have always used sensitized microbes, treated by heat at 56 degrees C. But it is incontestable that a living virus possesses vastly superior antigenic, and consequently vaccinal qualities, and that it should be preferred if its harmlessness can be thoroughly demonstrated. This is a point on which I have already insisted. I have already stated that to bring about the formation of antibodies, the antigen must be absorbed. I have also indicated how the serum, carried to the very seat of infection in local applications, *sensitized* the microbes and made them more susceptible to phagocytosis and to intracellular digestion. From this it will be deduced that sensitized vaccines, microbes charged with certain of their antibodies, will be readily absorbed and will consequently cause the precocious appearance of a great number of antibodies. Thus the characteristic quality of the immunity conferred by sensitized vaccines will be the rapidity with which it is obtained.

It cannot, however, be claimed that Besredka's method represents a sero-vaccination in the exact meaning of the word. By the use of sensitized vaccines, one benefits from a particular method of preparing the vaccines, extremely interesting for the reasons we have mentioned, but one does not obtain the full advantages offered by serotherapy. The microbic bodies absorb only a part of the active principles of the serum, those which facilitate their digestion, which might be compared to the antitoxins in the presence of toxins; but it is far from being proved that they are charged with all of that which, in a serum, goes to re-enforce the organic defense.

On the other hand, there exist the means of effecting a true sero-vaccination, and although up to the present surgeons have not had recourse to these means, I believe it will be well to speak a few words concerning them, for they have rendered such service that others will, perhaps, be glad to know of their existence.

There are three different methods of sero-vaccination—

a. *Mixture method.* This consists, as we have said, of placing the serum in contact with the virus, obtaining thus a neutral product which can be injected. This method presents great difficulties of which we have already spoken.

b. *Simultaneous method.* To obviate the inconvenience of the mixture method, injection of a certain quantity of serum and a certain quantity of virus have sometimes been made at the same sitting *but at different points*. By re-enforcing the organic defense, the injection of serum obviates whatever injurious effect might be caused by the injection of the virus alone.

c. *Dissociated method.* Finally, when immunity cannot be acquired by the mixture of serum and virus, there is still a way in which it may be sought other than by simultaneous injections. The process is carried out in two

sittings. The serum is first injected. This is followed, 5 days later, by inoculation with the virus. This was the procedure that was followed by Leclainche and Vallée when they succeeded in producing sero-vaccination for symptomatic anthrax, and in attacking the problems of the prevention of tetanus, Vallée and I worked with the same principles in mind. As soon as possible after infliction of the wound, we injected the customary dose of antitetanic serum to guard against immediate symptoms. Five days later, under cover of the protection conferred by the serums, we started the active immunization process with iodized tetanus toxin. We observed no untoward incidents in the course of our attempts.

The Respective Indications for Serotherapy and Vaccinotherapy

Surgeons attach great importance to the study of indications for operation, for they know that an operation, excellent in itself, may have deplorable results if it is not dictated by good judgment. The same sensible course must be followed in serotherapy and vaccinotherapy, if we are not to see two promising methods fall into unjust discredit, after having excited a rash enthusiasm. This is why I have been anxious to set forth in its entirety the problem which these questions raise, not concealing its obscurities and difficulties, but endeavoring to abstract some clear idea to guide us in practice.

First of all I wish to repeat, that, until we have more complete information, we must imbue ourselves with this idea, that the rational use of serotherapy or vaccinotherapy is dominated by the fundamental conception of specificity. Neglecting this, one may obtain incontestable therapeutic successes. It is even useful to know that, beside their specific action, serums, like vaccines, have a paraspecific action (colloidaltherapy, peptonic action) which it may sometimes be convenient to utilize, when one is ignorant of the germ of the disease which one is treating, or if there is no specific medicine for the germ.

Except in these cases, one's aim should always be to set up only the specific reactions. By proceeding thus, one will not deprive oneself of the primary paraspecific effects of serotherapy and vaccinotherapy, and will in addition obtain the benefits of their particular specific action.

How is one to chose between serotherapy, the action of which is rapid but transitory, and vaccination, which is slow in taking effect but produces durable results? Here, evidently, one must pass from general to particular grounds and consider cases individually. There are certain points that may be logically deduced from the principle already explained.

The first is that, in general, in the cure of infections, the first place must be given to specific serotherapy. It can have only an advantageous effect to spare the infected organism and immediately re-enforce its defense by the introduction of antibodies ready made. I allow myself to insist upon the importance of the employment of local serotherapy whenever it is possible.

When it concerns prevention of infections, the problem is different. Two cases are here presented which may be seen any day in surgery.

a. The infection feared is one that develops early. It is thus with tetanus and gangrene that may appear in the first few days following infliction of the wound caused by contamination. A quick defense must be made against these infections. There is no time for hesitation. Then rapid action imperially demands serum treatment. But if serum works quickly its duration is short. Now there are cases in which,—

b. on the other hand, the danger is long drawn out. A wound may be very long in healing. For some reason it may retain foreign bodies that carry germs. Cases of tetanus were seen during the war that developed several months after the injury. In these cases, should one continue indefinitely the injections of serum that become less and less efficacious as they are repeated? Assuredly, no. Serum is a medicine of quick but brief action. If duration of effect is desired, recourse must then be had to vaccine, and it is in obedience to these principles that M. Vallée and I produced the tetanus vaccination.

The fact that serums like all foreign albumins are less and less well received by the organism, as I have taken pains to make clear,

shows that they should not be employed except in those cases in which they are absolutely indicated, that is to say, in urgent cases, and I would repeat the statement that serum is the heroic treatment for serious cases, and it is reasonable not to impair the succor it is capable of affording by employing it when other therapeutic means could advantageously be substituted. It is for this reason that one cannot approve the abuse that is made of serums termed hæmopoietic, antihæmorrhagic, etc., used to combat surgical hæmorrhages, operative and otherwise. If such a practice is legitimate in the presence of characteristic hæmophilia, it is no longer so when applied to hæmorrhages of a non-menacing character, or due to an operation. The duty of the surgeon in all cases is to endeavor to assure a perfect hæmostasis and not to have recourse to lesser means, which, without producing decisive effects on the hæmorrhage, alter and vex, as I have stated, the humoral equilibrium of patients to whom they are applied.

Except in critical cases, one is not pressed for time and if the quality of the germs are adaptable, vaccination is better. The theoretical reasons for substituting vaccinotherapy for serotherapy whenever it is practicable are the following: The passive immunity conferred by the serum demands no effort on the part of the organism. This is at once its strength and its weakness. On the other hand, to acquire active immunity the organism is obliged to throw itself into a struggle which is expressed not only in humoral modifications, but also by a complete cellular education. In fact, as pointed out by Bordet: "In the vaccinated animals all the humors are active, while the fresh animal on which the passive immunity is to be conferred is hardly able to take one dose of relatively weak serum." One may also remark that the aptitude to produce antibodies usually persists a long time in vaccinated subjects so effectively that the organic defense remains good a long time after the humoral immunity has become considerably lowered. It seems, therefore, that one might validly place serotherapy, the action of which grows ever less as the injections are repeated, against vaccinotherapy, the effect of which is, on the contrary, re-enforced by each new series of vaccinations. I have already shown the practical conclusions which can be drawn from these theoretical ideas.

The Place Which Serotherapy and Vaccinotherapy Should Hold in Surgery

In spite of all the imperfections which they still present, it is impossible to deny the immense services which serotherapy and vaccinotherapy have already rendered to surgeons. They deserve henceforth to occupy a place in surgical treatment, and it is desirable that all surgeons should become more and more familiar with them and that they should know how to get the best out of them, as they endeavor to do with all the resources which operative technique places at their disposal.

While I am firmly persuaded that the latter will find in serums and vaccines more and more useful and necessary adjuvants that will augment its coefficient of safety, I believe, nevertheless, that the introduction of serotherapy and vaccinotherapy should not be allowed to obscure the great fundamental principles upon which the rational practice of surgery is based.

The war brought forcibly home to us one of these essential ideas, that the organism must be rid as quickly as possible of all mortified tissues, whether occasioned by trauma or by infection. There must be a clean field to obtain a prompt and satisfactory cure. One would be greatly deceived if one thought that the use of serums and vaccines could alter that primary truth. During the war I frequently heard it denied that anti-gangrenous serums possessed any prophylactic value, on the ground that the tissues of a wound, not surgically treated, presented areas of gangrenous appearance in spite of the previous injections of serum. But I replied, without always being believed, that the serum had, nevertheless, acted beneficially in neutralizing the toxins secreted by the germs, and permitting the gangrene to remain a local, and therefore curable, condition, instead of becoming a general toxæmia, almost certain to prove fatal. The logical treatment of wounds should therefore be twofold; surgical, to cut away all the tissues mortified by the traumatism, which have no longer a right of domicile in the body;

serum treatment, to protect the patient against all general complications, septic and toxic, that may arise in the region of the wound.

The impotence of serums and vaccines when face to face with tissue necrosis helps us to understand the difficulties met with in using them in certain chronic diseases, especially tuberculosis. All who have undertaken the cure of that formidable disease have made the same observations. Regarding the results of his experience with tuberculosis vaccine therapy, M. Jousset writes me: "You know as well as I that there is nothing to do in tuberculosis of the bone unless surgery participates in the treatment by removing sequestra, fungosities and necrotic parts. On the other hand, tuberculosis attacking the soft tissues where spontaneous elimination is easy, is *a priori* in the province of vaccinotherapy."

What M. Jousset has stated regarding tuberculosis, which agrees with what I have myself seen, my personal experience allows me to say regarding serotherapy and vaccinotherapy in all surgical infections, and this leads us to ask: Since serotherapy and vaccinotherapy must be considered only as auxilliary to surgery, in what measure and how can they serve as adjuvants to operation?

Employed judiciously in suitable doses the serums and vaccines may sometimes save, and very often limit, the surgical intervention. Reporting in May, 1921, to the Society of Surgery the results obtained by the use of the microbic extracts with which I had at that time been experimenting for more than 3 years and the action of which might perhaps be compared, in certain respects, with that of vaccines, I showed that where they were applied at the commencement of an infection, when only the purely congestive inflammatory symptoms were present, the infection was seen to turn abruptly and the tissues reassumed their normal suppleness and relaxation. When, on the contrary, there was the least tendency to suppuration, this immediately appeared. But instead of being diffuse it gathered to a point, so that it could be evacuated by an operation which caused but slight mutilation, a puncture with bistoury or needle and filiform drainage. Many surgeons have made the same observation. Some have even counted upon the focal reactions provoked by serums or vaccines to procure a spontaneous elimination of sequestra and foreign bodies. Others have not only seen the pus become sterile but even be absorbed. These are eventualities upon which it is better not to depend. No form of elimination is better or more regular than that which is carried out, according to plan, by the surgeon, and I think the serums and vaccines will play a sufficiently useful rôle if they reduce the size of the field of operation, guard against the extension of the infection, and allow a quicker and easier cure.

But it is not here that the chief importance of serums and vaccines lies. I believe that their study must tend to make the results of surgical operations more constant. A great advance was brought about by antisepsis, and, later, by asepsis, which abolished contamination of the patient by the surgeon or his instruments. But if the operator is no longer the origin of infection, in the greater part of his operations he finds it already installed. Infection is still his most formidable enemy. Too much importance can never be attached to the study of what has been termed latent microbism. When one speaks of immunity, one always thinks of the immunity of the organism against its aggressor, the microbe. But the microbe is also a living being and, on its side, the seat of reactions of defense against the organism that harbors it. Which of these two has the better succeeded in protecting itself against the other? That is the enigma which we face each time we operate upon a "*germ carrier*," for we must not conceal from ourselves the fact that our intervention unchains the elements of a conflict of which we can foresee neither the incidents nor the end, since we do not know the respective forces of the two combatants. Here again serums and vaccines give us valuable assistance by allowing us to establish a pre-operative immunization.

The large number of cases of tetanus observed after repeated operations on war injuries led many surgeons to recommend the injection of antitetanic serum before each new operation. It appeared to me, as to my preceptor Quénu, that this indispensable precaution might well be supplemented by the addition of anti-gangrenous serum and on March

21, 1917, I dedicated to the Society of Surgery a communication on the use of Leclainche's and Vallée's serum in the prevention of post-operative infections. At that time, impressed by the flare-ups of infection, sometimes fulminating, that follow operations, I operated no more on war injuries except under the protection of serotherapy or vaccination.

The theories and results derived from war surgery can be transferred to surgery as practiced in time of peace.

In the case of an open infection for which surgical intervention will some day be necessary, there is every advantage in preparing the patient by a pre-operative autovaccination. Convalescence will be greatly facilitated. After having employed this method for many years, on June 26, 1922, I presented before the Académie des Sciences the results that my father and I had obtained, notably in urinary surgery. But the infection requiring operation is not always open. In that event it is not possible to isolate the germ or germs responsible for it, to make use of them in the preparation of an autovaccine. It is still possible, however, to produce a pre-operative immunization, although with less certainty. In such a case one should do as I did at the commencement of my researches in 1916, i.e., use a very polyvalent stock vaccine containing those germs which numerous examinations have shown to be the most frequent in the infection under consideration. But in the course of my work of immunization, particularly in appendicitis, I have observed that the injection of vaccine, especially when given intradermally (intradermo-reaction), provoked in certain patients an extremely acute local reaction analogous to that provoked by tuberculin in the tuberculous. It has seemed to me that this should be interpreted, like the latter, as a peculiar sensitiveness on the part of the patient to the germ under consideration, in this case the colon bacillus. I have used this intradermo-reaction to the colon bacillus before all my operations for chronic appendicitis, and on March 12, 1919, communicated the results of my work to the Surgical Society. I believe that this use of vaccines for prognostic purposes is extremely important. It is, to my mind, of the utmost value to the surgeon to be informed as accurately as possible as to the condition of the terrain on which he is operating. Everyone will have remarked that operations technically simple and satisfactory sometimes end in inexplicable failures, while others that seemed to be performed under less propitious conditions, are followed by uncomplicated healing. This is to be explained on the grounds that, in the first case the operation set free a germ of increased virulence which developed in a terrain of lessened resistance, whereas in the second, the organic resistance was acting normally. The greater part of the symptoms termed "operative shock" are nothing else than the manifestations of a very acute septicæmia. The object of the pre-operative intradermal reaction which I have recommended is to furnish information as to the strength of the organic defenses and to enable us to discriminate between sensitive subjects, upon whom it is better not to operate until their sensitiveness has been lowered by an appropriate vaccination, and patients with normal reaction on whom immediate operation may legitimately be performed.

Researches made by M. Lambret and communicated by him to the Surgical Society on June 22, 1921, confirm my point of view in all respects. Struck by the frequency of pulmonary complications in patients operated on for lesions of the stomach, and finding that the same germs which he could isolate regularly from the surface of the gastric mucosa during his operations were present at autopsy in the lungs of patients who had died from bronchopneumonia following operations on the stomach and in the sputum of patients with pulmonary reaction, M. Lambret, collaborating with Mm. Breton and Grysez of the Pasteur Institute of Lille, had the idea of immunizing patients before operation by vaccinating them for the germs most often met with (bacillus pylori and enterococcus). But in order to vaccinate only those who were "germ carriers" Mm. Lambret, Breton, and Grysez had recourse, as have I myself in other abdominal infections, to the intradermal reaction, operating immediately where the reaction was negative, vaccinating previously in cases where it was positive. The value of this pro-

ceeding may be appreciated when I state that M. Lambret, whom I recently met, told me that with previous vaccination he had been able to perform a series of 50 consecutive operations on the stomach without a single complication, and that when, as a means of control, he had suspended the practice of preoperative vaccination, he had one death in the four cases that followed, which made him more than ever determined not to forego so valuable an adjuvant. I was pleased to find in the researches of M. Lambret a confirmation of what I had presented to the Surgical Society more than 2 years before.

A splendid field is here open to investigators: the study of the terrain in surgery, which includes investigation of the organic defenses and of all forms of microbic adaptation.

In speaking of serotherapy and vaccinotherapy there is a tendency to see nothing in the serums and vaccines but therapeutic means. In closing, I wish to show that they hold out other hopes. In presenting this work I have not tried to conceal the failures of vaccinotherapy and serotherapy nor the obscurity that still surrounds their action. It may even be asked whether the serums and vaccines are not at present in a transitory stage, destined sooner or later to modification. It is for this reason that I have restricted myself voluntarily to general ideas and have not attempted to present results. Wonderful as these last have been, I do not think they have formed my chief interest in the study of serums and vaccines. If serotherapy and vaccinotherapy have enabled me to render valuable services and to assure recovery to many of my patients, they have above all else obliged me, in my desire to employ them rationally, to observe their effects in the hospital and to compare them with the information furnished by laboratory experiments. A new direction has been given to my mind, and I appreciate more fully the necessity that is being more and more imposed upon the surgeon of our day, to think not only as anatomist, but also as biologist.

AN ELECTRO-CHEMICAL INTERPRETATION OF SHOCK AND EXHAUSTION[1]

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In former publications[1] were given summaries of the various theories regarding the mechanism of shock and exhaustion and conclusions from the researches of my collaborators and myself up to the time of preparation of those manuscripts. In this present report it is my purpose to summarize the reports of various investigations regarding the nature of shock which have appeared in the more recent literature; to describe in some detail the later researches in my own laboratories; to add certain modifications to the theory of the operation of the animal mechanism (based on these laboratory findings) which I have previously proposed; and to describe the practical application of this present conception in the clinic, especially in the management of "bad-risk" patients; i. e., of patients in whom the processes of shock and exhaustion are already initiated.

While the published bibliographical lists are fairly rich in titles bearing upon some phase of "shock," but little work along new lines has been reported. Laboratory studies appear to have been devoted principally to further investigations of the theory that traumatic shock is due to the absorption of tissue poisons[2] and to the study of the distribution of the blood in shock.[3]

Henderson, in collaboration with Haggard and Coburn, has written further in support of his acapnia theory.[4]

From his studies of the alkali reserve of the blood plasma, Raymond[5] has concluded that there is no relation between the relative severity of shock and the degree of depletion of the alkali reserve. Contrary to our own findings he reports that the intravenous injection of acids failed to produce either shock or any allied condition, a finding reported also by Cannon and Cattell.[6] The latter authors note the conserving influence of morphine on the alkali reserve, probably as the result of reduced cellular activity.

Rapport[7] reports a research undertaken for the purpose of determining the possible relation to the production of shock of an over- or under-production of epinephrin. In six out of nine cases he found evidence of hyperactivity of the adrenal glands during the development of traumatic shock, but thinks it probable that this hyperactivity acts as a conserving agent rather than to promote the production of shock.

Of particular interest from the point of view of our own studies are certain of the conclusions of Whipple, Smith and Belt[8] from their studies of the relation of blood proteins to shock.

> The *essential injury* in these experiments is *cell protoplasm injury* induced by a sudden change in the colloidal solution which forms the normal environment of these cells. This may be a new type of cell injury, but it may help us to understand the more complex cell injury which is probably responsible for "surgical shock."

These investigators found that while the presence of injured cells of the kidney, pancreas, or intestine did not seriously modify the reaction which followed a uniform "plasmapharesis",

> . . . . the presence of *injured liver cells does profoundly modify the expected reaction* following a unit plasmapharesis. A fatal shock reaction is almost constant following even a moderate plasma depletion preceded by liver injury.

[1] Crile, G. W. The mechanism of shock and exhaustion. J. Am. M. Ass., 1921, lxxvii, 149-155. A Physical Interpretation of Shock, Exhaustion and Restoration, London, 1921.

[2] Bayliss, W. M. Action of gum acacia on the circulation. J. Pharmacol. and Exp. Therap., 1920, xv, 29-74.
Dale, H. H. Conditions which are conducive to the production of shock by histamin. Brit. J. Exper. Path., 1920, i, 103-114.

[3] Mann, F. C. Experimental surgical shock. Am. J. Surg. (Anesthesia Supp.), 1920, xxxiv, 11-14.

[4] Henderson, Y., Haggard, H. W., and Coburn, R. C. The acapnia theory, now. J. Am. M. Ass., 1921, lxxvii, 424-427.

[5] Raymond, B. Alkali reserve in experimental surgical shock. Am. J. Physiol. 1920, liii, 109-136.

[6] Cannon, W. B., and Cattell, McK. Experimental traumatic shock. Arch. Surg., 1922, iv, 300-323.

[7] Rapport, D. Studies in experimental traumatic shock. Am. J. Physiol., 1922, lx, 461-475.

[8] Whipple, G. H., Smith, H. P., and Belt, A. E. Shock as a manifestation of tissue injury following rapid plasma protein depletion. Am. J. Physiol., 1920, lii, 72-100.

[1] Presented before the International Congress of Surgery, London, England, July 17-20, 1923.

This would indicate that the liver cells are particularly concerned in the peculiar shock reaction which may follow plasmapharesis and lowering of the blood plasma protein values. It may be that this type of shock is not unlike the common "surgical shock."

The evidence in our experiments gives strong support to the theory that in "shock" there is a *primary cell injury* which *precedes* the familiar *clinical reaction.*

The continued studies of Cannon,[9] Stewart and Rogoff,[10] Marine[11] and others on the function of the adrenals and other glands with internal secretion should be included also, as of constant value in the interpretation of the syndrome of shock and exhaustion.

Throughout our own investigations the work of the many investigators in this field has constantly suggested, aided, and checked our studies.

As has been stated in previous publications, our researches which were initiated to investigate the cause of exhaustion due to physical trauma—surgical shock—have been extended to include all the known causes of exhaustion. These investigations have served, first, to identify the organs and tissues which are affected by the various causes of exhaustion; and, second, to ascertain whether or not identical end-effects are produced in these organs by all the causes of exhaustion. That is, they have shown that infection, exertion, emotion, asphyxia, the excision of organs, etc., cause phenomena which are identical with those produced by the commonly accepted causes of shock—physical trauma and hæmorrhage, that identical organs are affected by each of the causes of exhaustion, and that the change in each is the same whatever the cause of the exhaustion.

In each instance, however, the histological picture, the physiological phenomena—alteration in blood pressure, diminution in the alkali reserve, changes in the H-ion concentration of the blood—were end-results. In no instance did our own studies or those of any of the many other investigators in this field indicate the *cause* of shock or exhaustion.

Since every method of physiological investigation had been tried by ourselves or others without avail, we turned our attention to the possibility of applying other methods of investigation.

The uniform finding in our histological researches that progressive changes in the cells of the central nervous system, the liver and the adrenal glands, paralleled the clinical phenomena of stimulation and exhaustion, led us to turn our attention to a study of the ultimate component units of the organism—the cells.

FUNDAMENTAL STRUCTURE AND FUNCTION OF THE CELLS

Every living cell consists of two parts, the nucleus and the cell body, separated from each other by a selective semi-permeable membrane. The cell itself also is separated from neighboring cells or from the medium in which it is immersed by a semi-permeable membrane. The nucleus and the body of the cell cannot be best stained by the same medium, that is, the nucleus takes best an acid stain, the remainder of the cell takes best a basic or alkaline stain.

The content of the cell body and of the nucleus consists in the main of colloidal solutions. Two colloids of different reactions separated from each other by a semi-permeable membrane constitute an electric cell. Each cell of the organism therefore is a true electro-chemical unit—an electric cell.

Since all the organs and tissues of the body are multiples of these ultimate electro-chemical units, then each organ and tissue must be an electro-chemical mechanism, as must the organism as a whole. If the organism is made up of electro-chemical units, then its func-

[9] Cannon, W. B. Some conditions controlling internal secretions. J. Am. M. Ass., 1922, lxxix, 92–95.
Studies on conditions of activity of the endocrine glands, with Griffith, F. R., Am. J. Physiol. 1922, lx, 544–559; with Smith, P. E., Am. J. Physiol., 1922, lx, 476–495; with Rapport, D., Am. J. Physiol., 1921, lviii, 308–337; 338–352; with Uridil, J. E., Am. J. Physiol., 1921, lviii, 353–354; with Uridil, J. E., and Griffith, E. R., Endocrinology, 1921, v, 729–730.

[10] Stewart, G. N., and Rogoff, J. M. Postoperative depletion of epinephrin store of adrenals, Am. J. Physiol., 1921, lvi, 220–230. Action of drugs on output of epinephrin from adrenals, J. Pharmacol. and Exper. Therap., 1922, xix, 59–85. Influence of muscular exercise on normal cats compared with cats deprived of greater part of adrenals. J. Pharmacol. and Exper. Therap., 1922, xix, 87–95. Influence of morphine on normal cats and on cats deprived of greater part of adrenals, J. Pharmacol. and Exper. Therap., 1922, xix, 97–130. Morphine hyperglycæmia and adrenals, Am. J. Physiol., 1922, lxii, 93–112.

[11] Marine, D. Influence of glands with internal secretion on respiratory exchange; with Lenhart, C. H., Am. J. Physiol., 1920, liv, 248–260; with Bauman, Am. J. Physiol., 1921, lvii, 135–152; ibid., 1922, lix, 353–368.

tions must depend upon the laws of physics, and it should be possible to measure variations in its function by physical methods.

We reasoned that if physical methods of measurement could be applied to the various organs and tissues of the body it would be possible to measure variations in cellular vitality with an accuracy comparable to that of measurements of length or of mass by means of the centimeter and the gram; and by the variations in the cellular activity of the different organs and tissues to gain a new insight into the operation of the animal organism and consequently to determine the fundamental processes concerned in the production of shock and exhaustion.

ELECTRICAL CONDUCTIVITY MEASUREMENTS

The applicability of this physical method of measurement to our problem was suggested by the researches of Osterhout on the electrical conductivity of plants; and those of Loeb, Lillie, and others[1] on the permeability of cells in the process of fertilization. We assumed that variations in the permeability of the living cell to the electrically charged elements—ions—of the fluid which surrounds it must parallel variations in irritability in response to stimulation; and therefore, that factors which diminish, suspend, or abolish irritability must also diminish, suspend, or abolish alterations in permeability.

To this end, therefore, a research was undertaken in which measurements were made of tissues from normal adult and immature rabbits, and from fetuses, and from rabbits subjected to various types of exhaustion—insomnia, exertion, fright, infection, surgical shock; to the action of various drugs—stimulant and depressive; to short and prolonged anæsthesia by ether and by nitrous oxide; to the action of adrenalin in single and in repeated doses; to thyroid feeding and to acute iodism induced by the injection of iodoform; to the injection of acids and of alkalies; to the excision of organs—the thyroid, the liver, the adrenals.

The tissues and fluids measured included the cerebrum, the cerebellum, the spinal cord, the liver, the thyroid, voluntary muscle, the heart, the kidneys, the spleen, the lung, the spinal fluid, the blood, the bile.

A complete report of the methods employed in this research with the actual measurements has appeared elsewhere. We[2] shall include here only the general conclusions from our findings.

1. Influences which affect the general physical condition of the organism produce changes in electric conductivity in the dominating reactive tissues, these changes being uniformly and measurably manifested in the brain and the liver. Apparently these changes in conductivity appear more promptly than any gross clinical alteration.

2. Apparently the liver is more promptly and more markedly affected than any other tissue, as animals showing either no or very slight changes in the conductivity of the cerebrum and of the cerebellum will often show a marked alteration in the conductivity of the liver. On account of the wide variation in liver measurements and the apparent susceptibility of this organ to seasonal and environmental changes, the effects of applied agents are best determined by measurements of the cerebrum and cerebellum.

3. A study of the individual measurements from which the averages have been computed seems to indicate that the variations represent slightly different stages in a process that varies in rate in different animals and in the different organs of the same animal.

4. In view of the above indication and the direct evidence of the measurements, we feel justified in the assumption that the first effect of stimulation within the organism is a slight decrease of the conductivity of the liver followed by a rapid continuous rise to above the normal as the state of exhaustion approaches; a slight and prompt increase in the conductivity of the cerebellum followed by a gradual continuous fall; a relatively slower increase in the conductivity of the cerebrum followed by a gradual continuous decrease.

5. These studies indicate that electric conductivity measurements provide a means by

[1] See bibliographical list in article cited below.

[2] Crile, G. W., Hosmer, H. R., and Rowland, A. F. The electrical conductivity of animal tissues under normal and pathological conditions. Am. J. Physiol., 1922, lx, 59–106.

which the interpretation of the normal operation of the organism may be furthered and the progress of pathological processes within the various organs and tissues may be measured.

6. From our findings it would appear that the *intracellular* changes in excitation and exhaustion which are revealed by the microscope are paralleled by alterations in electrical conductivity, and that both the histological and electrical changes bear a direct relation to the vitality of the organ.

MEASUREMENT OF TEMPERATURE CHANGES BY MEANS OF THERMOCOUPLES

The studies thus far summarized appeared to demonstrate a definite relationship between histological changes and electrical conductivity, this relationship constituting strong evidence in support of the electro-chemical theory. Nevertheless, it was necessary to demonstrate that these apparently related findings are not merely coincident conditions but that actual changes in *function* correspond to the observed changes in electric conductivity and in microscopical appearance. Moreover, both histological studies and measurements of electrical conductivity must be prosecuted after the death of the animal, although with proper precautions it is reasonable to believe that the changes noted at least parallel the progress of processes in the living animal. However, to determine finally whether or not the variations in the histological picture and in the electrical conductivity are parts of one and the same process as that manifested by changes in functional activity, it was necessary to devise some method by which the functional changes in the cells might be measured in the living animal. Only by such a measure could it be ascertained whether or not changes in electrical conductivity indicate changes in functional activity. Clinical evidence would appear to demonstrate that this is the case, but clinical evidence cannot be accurately measured, nor does it identify without question the organs which are principally concerned. Some accurate index that could be applied to the organ itself in the living animal was essential.

In an electro-chemical mechanism, variations in functional activity indicate variations in oxidation; variations in oxidation are manifested by variations in heat production. If heat is a constant product of functional activity, then, if we could measure the progressive changes in the temperature of the various tissues and organs during the various phases of excitation and exhaustion under conditions identical with those formerly studied, we not only should be able to check our findings in the previous researches but should be able finally to link those findings with the clinical evidence.

As the first means to this end we decided to use the method of measurement employed by physicists for the measurement of minute temperature variations, that is, to employ thermocouples so constructed that they could be applied to the brain, liver, muscle or other tissue of the living animal.

Reports of this research have been published[1] and as in the case of our electric conductivity measurements, only a brief summary of our findings will be included here.

1. From the very beginning it was evident that variations in the temperature of the brain under varying conditions parallel variations in the histological picture and in the electrical conductivity of the brain under the same conditions. Thus, the progress of exhaustion from any cause was marked by a progressive decrease in the temperature of the brain and the liver, the rapidity of which was in direct relation to the rate at which the degree of exhaustion advanced.

2. The stage of excitement of ether anæsthesia was marked by an increase in the temperature of the brain; but during surgical anæsthesia the temperature fell continuously until death.

3. After hepatectomy the temperature of the brain declined progressively until death, the resultant curve corresponding closely to that produced by continuous ether anæsthesia.

4. Muscular activity, either voluntary or induced by direct electrical stimulation of a nerve, was accompanied by rapid alterations

[1] Crile, G. W., Hosmer, H. R., and Rowland, A. F. Thermo-electric studies of temperature variations in animal tissues. Am. J. Physiol., 1922, lxii, 341-382.
Crile, G. W., and Fricke, Hugo. Application of biological research to medical problems. Tr. Am. Philosophical Soc., 1922, lvi, 237-245.

in the temperature of the brain and the liver corresponding to the phases of the muscular activity—these alterations, however, *being in opposite directions.*

5. *No significant alteration in the temperature of the liver* was produced by the injection of strychnine, of an acid or of an alkali, *although marked and characteristic changes,* corresponding in each case to the clinical phenomena, were produced by each in the temperature of the brain.

6. Exposure of the viscera and abdominal trauma alike produced a rapid fall in the temperature of the brain and the liver, the change in the latter being in part but not entirely accounted for by the direct chilling of the liver substance.

7. The restorative effect of the introduction of hot water into the stomach was marked by an immediate elevation of the temperature of the brain *which measurably preceded—in some instances by a minute or more—the resultant elevation in the temperature of the liver.*

8. Of especial significance were the temperature changes which followed the injection of adrenalin under varying conditions.

a. In normal animals the temperature of the brain was increased by adrenalin, but returned immediately to or below the preceding level;

b. *In normal animals the temperature of the liver was not significantly affected by the injection of adrenalin;*

c. A limited number of observations indicated that the temperature of the spleen, the kidneys, voluntary muscles and intestinal walls was *decreased* by the injection of adrenalin;

d. *In the absence of the liver the injection of adrenalin produced a diminished or no change in the temperature of the brain;*

e. In the absence of the thyroid the reaction of the brain to adrenalin was less than in normal animals;

f. In iodized animals the reaction to adrenalin appeared more promptly and was greater than in normal animals;

g. After adrenalectomy the reaction to adrenalin was approximately the same as in normal animals;

h. In morphinized animals adrenalin increased the temperature of the brain, but this increase was less than in normal animals and was maintained for prolonged periods;

i. After the administration of strychnine, adrenalin caused an abrupt rise in the temperature of the brain and an abrupt fall in the temperature of the liver;

j. After hæmorrhage the injection of Bayliss solution diminished the reaction of the brain to adrenalin;

k. The transfusion of blood after hæmorrhage did not affect the normal reaction of the brain to adrenalin.

Of particular significance were the findings, (a) that in voluntary muscular activity and as a result of the direct electrical stimulation of a nerve, the temperature of the brain and of the liver varies in opposite directions; (b) that upon the introduction of hot water into the stomach the reaction of the brain in increased temperature precedes that of the liver; (c) that the temperature of the liver is but little altered or is unchanged by the injection of adrenalin; of strychnine; of an acid; of an alkali.

The findings in these studies which accord with the histological studies and the electrical conductivity measurements support the conclusions: (a) that the brain is the tissue upon which depends the reactions of the organism to stimulation; (b) that the thyroid and the adrenals play essential parts in the production and maintenance of these reactions; (c) that in the performance of its function the brain is indissolubly linked with the liver.

The lack of response of the brain to adrenalin in the absence of the liver together with the opposite reactions of the brain and the liver form vital links in the chain of evidence whereby we may determine the function of each in the electro-chemical operation of the animal mechanism, and indicates for the liver a new rôle of highest importance.

MEASUREMENT OF ELECTRICAL CAPACITY

If our conception that the organism is operated by means of electrical charges produced by oxidation and accumulated in the cells is correct, then measurements of the

capacity of the cells to store electricity would give information of the greatest value. An original method and apparatus for this purpose have been devised in our laboratory by Hugo Fricke, Ph.D., and measurements are being made in collaboration with C. Nusbaum, Ph.D., of the Case School of Applied Science, and others. Dr. Fricke's initial measurements indicate that the cells have a very high capacity for the storage of electricity.

From these measurements it is possible to calculate the thickness of the semi-permeable membrane of the cells which are of the order of 1/10,000,000 of a centimeter in thickness. It would appear that this membrane is an oil film of one layer of oil molecules in thickness. Such a membrane in itself is an ideal means for the storage of high electrical charges.

These biophysical studies offer strong evidence in support of our fundamental premise that the cells of the organism are electrochemical units. The efficiency of an electric battery depends upon the maintenance within it of a difference in potential. The maintenance of life which we conceive to be dependent upon a difference in potential in the organic battery would demand, among the various other things, a constant supply of oxygen and a constant supply of a solvent and catalyst.

It is of importance, therefore, to consider the essential rôles of water and of oxygen in the cell.

THE ESSENTIAL RÔLES OF WATER AND OF OXYGEN IN THE CELL

Water. The properties of water which make it of essential value in the cells may be briefly summarized as follows: Water is the only medium in which a colloidal system can be established; water has a greater catalytic power than any other substance; water is a chemical activator; water has a greater specific heat than any other substance; pure water is a non-conductor of electricity; "moreover it is only in the presence of water that oxygen has the power of oxidizing rapidly" (Mathews); and therefore before oxygen can become available for use within the cell it must be dissolved in water.

Oxygen. The mechanism within the cell for the utilization of oxygen has been well described by Mott:[1]

> If living cells are examined microscopically with dark-ground illumination, they are seen to be filled with small granules or globules, each of which, after escaping from the cell, remains discrete. They are refractile, and appear white and luminous; this is due to a delicate covering film of a lipoid substance which encloses a colloidal fluid, probably consisting of a solution of salts and cell globulins. When the cell dies this colloidal fluid is coagulated, and the precipitated proteid substance is massed together into little blocks—the Nissl granules; the intervening denser colloidal substance is continuous with the colloidal substance of the axon and dendrons. The film that covers each globule is stainable by vital methylene blue, and a living nerve cell stained by vital blue presents the appearance of an emulsion of minute, faintly blue globules. If the living cell thus stained be kept in an atmosphere of nitrogen in a warm chamber the stored oxygen is used up and a leuco-base is formed, causing the globules to lose their color, and the cells appearing of a greenish tint. On admission of oxygen the living cell again becomes blue. It thus appears possible that these granules represent a large oxygen surface, like spongy platinum, within the cell. When the cells die, the lipoidal film of the globulin-containing fluid is destroyed, coagulation occurs, and the Nissl granules are formed. These facts accord with the knowledge that stimulation of a piece of nerve causes practically no metabolic change or using up of oxygen; therefore the mere conduction of a stimulus along a nerve does not entail loss of neuropotential. The chemical processes incidental to the using up of nervous energy in the neuron take place in the cell itself and at the synapses of the terminal fibrillæ, and for this reason it is that the blood supply of the gray matter is six times that of the white matter. In all active neural processes oxygen is used up and carbonic acid is produced which escapes into the circumambient cerebrospinal fluid. One stimulus differs from another that is discharged into a cell by variation in modes of motion, and it is conceivable that the granules which fill the cell are sensible to the varying modes of motion, and an oft-repeated stimulus suffices by the establishment of a biorhythm in the cell to pass through to the intercalary neuron with little expenditure of neuropotential, whereas a new stimulus which requires a concentration of attention must be either transformed or reinforced before connection of the terminals of Neuron I with Neuron II can take place, and this involves a using up of neuropotential.
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> It is known that a continuous supply of oxygen is essential for consciousness. The bulk of the cortex is supplied by the internal carotid arteries;

[1] Mott, F. W. War Neurosis and Shell Shock. London: 1919. 11–14, 15.

compression of these arteries causes loss of consciousness in about five or six seconds. Histological investigation tends to show that the intercalary neurons have no store of oxygen in their cytoplasm; they depend, therefore, upon a continuous renewal of the oxygen in the circumambient fluid; consequently, as soon as the capillary circulation ceases, they feel the effect of lack of oxygen and cease to function, causing dissociation to occur. It may be hypothecated that a violent emotion such as fright can, by its influence on the vasomotor center and the heart's action, causing a fall in the blood pressure, produce an immediate lowering of oxygen tension in the fluid, and thereby suspension of function of the intercalary neurons of the cortex, followed by dissociation of the cortical perceptors and loss of consciousness.

Oxygen—the "acid-maker"—then is essential to the life of the cell. Oxidation produces acids. These acids produce the essential alterations in the difference of potential between the nucleus and the cell-body and probably between parts within the cytoplasm (Mott) as a result of which accumulations of acid and an adaptive discharge of energy are provided. Water carries the oxygen in solution to the cells; dissolves the acid by-products of oxidation; and bears them away from the cells, thus constantly restoring the acid-alkali balance which is as constantly altered by the acidulating oxidation. In accordance with the electro-chemical conception, therefore, water and oxygen in a vital and inseparable relationship make possible the electrical variations within the cells, the manifestations of which constitute life.

These biophysical studies appear to justify the following conclusions regarding the operation of the cells.

Oxidation takes place only in cells; but cells have the power of oxidation only when there is a difference in potential between the nucleus and the cytoplasm. The difference in potential is maintained by oxidation.

If the electrical charges of the cells are produced by oxidation, then it follows that the part of the cell having the highest rate of oxidation, viz., the nucleus, would be positively charged as compared with that part of the cell which has a lower rate of oxidation, viz., the cytoplasm; and the electrical current would pass from the point of higher potential —the (comparatively) positive nucleus—to the point of lower potential—the (comparatively) negative cytoplasm.

If not only the constituent cells but the organism as a whole operates in accordance with physical laws as an electro-chemical mechanism, it is necessary to identify an organ or tissue of highest potential, and an organ or tissue of lowest potential; and to identify the direction of the electrical currents between them. Our biophysical studies appear to indicate that these two "poles" of the organic mechanism are the brain and the liver. That the cortex of the brain has a higher rate of oxidation than any other organ or tissue is probable, for Alexander and Cserna's figures show a consumption in the brain of 0.360 cubic centimeter of oxygen per gram-minute as compared with 0.004 cubic centimeter in skeletal muscle.

Our temperature measurements of the variations in temperature in stimulation showed a marked increase in the brain as compared with a decreased or unaltered temperature in the liver and other organs and tissues.

The opposite effects of stimulation and of exhaustion on the electric conductivity of the brain and of the liver indicates a specific antithetic electric relationship between them.

Other evidence in favor of this assumption is found in the following facts regarding the interrelationship of the brain, the liver and the adrenal glands.

The liver and the brain and oxygen without the adrenal glands are inert.

The adrenal glands and oxygen and the brain without the liver are inert.

The liver, the adrenal glands and the brain without oxygen are inert.

The liver, the adrenal glands, the brain and oxygen together, are inert when the differential stainability of the nerve cells is lost—that is, when the nerve cells have ceased to be efficient batteries.

Such an interrelationship cannot be demonstrated in regard to any other organs or tissues. The function of the adrenal glands being the control of oxidation, these facts considered in their relation to the experimental findings cited above appear to indicate that the brain represents the positive

pole and the liver the negative pole of the organic electro-chemical mechanism.

In accordance with this conception, since all cells of the body are immersed in fluids which are rich in electrolytes, it would be by means of those fluids and the nerves that the circuit between the point of highest potential—the brain—and that of lowest potential—the liver—would be completed.

When the oxidation in the brain is increased by psychic, traumatic, or chemical excitation, the electricity produced by the increased oxidation would pass from the brain along the nerves to the areas of lower potential in the muscles and glands and finally to the point of lowest potential—the liver, returning to the brain via the electrolytic solutions in which the system is immersed.[1]

DEFINITION OF SHOCK AND EXHAUSTION

The conception that man is an electro-chemical mechanism supplies an interpretation of the principal phenomena of quiescence, stimulation, and exhaustion which constitute normal life; it supplies a new basis for the analysis of pathological phenomena.

In accordance with this conception, exhaustion is the result of a diminution of the difference of potential between the poles of the organism, due to a decrease in the brain, which in turn results from a decreased difference in the potential in its constituent cells. This conception explains the identity of the phenomena of exhaustion and the progressive degrees of exhaustion to "shock." When the difference in potential reaches zero, the organism is dead.

CLINICAL APPLICATION OF THE CONCEPTION THAT MAN IS AN ELECTRO-CHEMICAL MECHANISM

If the conception that man is an electro-chemical mechanism is correct, then it should be possible to apply the laws of physics and chemistry to the interpretation of the action of therapeutic agents and measures. Since the electro-chemical theory identifies the organs, the integrity of which is essential to the efficient operation of the mechanism; it should indicate the means by which the organs may be safeguarded against the processes of disease and injury; it should determine the most efficient means of supplying the essential elements of the cells—water and oxygen; it should emphasize the paramount necessity of rest and sleep; it should indicate the need of aiding failing organs by the administration of their essential products; it should direct the selection and gauge the safe application of anæsthetics; it should determine the selective application of drugs; it should guide the hand of the surgeon; it should lead the clinician to protect his patient against the excessive driving of environmental as well as of internal stimuli.

For the past 2 years the treatment of the patients in our clinic has been based upon the conception that the difference in potential between the nucleus and cytoplasm of the cells as well as between the essential organs of the electro-chemical system must be maintained; and in accordance therewith we have adopted the following main principles as our guide in the protection and restoration of our patients:

1. The organism needs an abundant supply of fresh water.
2. An abundant supply of oxygen must be delivered to the cells.
3. The permeability of the selective semi-permeable membranes must be maintained within a normal range.
4. Both the local and the general temperature of the body must be kept at or near the normal.
5. An abundance of mental and physical rest and an abundance of sleep are essential.
6. The physical structure of the cells must not be impaired by the indirect effects of the trauma of the operation nor by the anæsthetic.

By the practical application of these principles the two essential factors in the maintenance of the integrity of the electro-chemical system are assured, provided recovery is anatomically possible and the disintegration

[1] In connection with these conclusions recent investigations by Cannon and by Renauld-Copart are especially significant.

Cannon, W. B., and Griffith, F. R. Studies in the conditions of activity of the endocrine glands: X. The cardio-accelerator substance produced by hepatic stimulation. Am. J. Physiol., 1922, lx, 544–559.

Renauld-Copart, H. Contribution à l'étude du metabolisme cerébral par la methode des circulations partielles. Arch. internat. de physiol., 1921, xvi. 21. 43.

of the cells has not progressed to the early stages of inevitable dissolution; that is, provided the acid-alkali balance—the difference of potential—within the cells is maintained or restored, and their internal respiration is protected.

Every patient is given the benefit of the application of these principles, modified only by the nature of the disease processes in the individual case.

While the treatment of each patient is individualized, nevertheless, the employment of the protective measures we shall describe has become practically a routine; for in all cases, and pre-eminently in the case of the "bad-risk" patient, the management is based on *possibility* and directed by *probability*, not by the physical state of the individual patient at the moment. This conception is comparable to the principle of preventive medicine; that is, in the case of the "bad-risk" patient we do *in advance* of exhaustion or shock all that we would do should these develop.

The practical application of the principles cited above is achieved by the following measures:

In "bad-risk" cases, nitrous oxide-oxygen *analgesia*—not anæsthesia—with local anæsthesia is employed to avoid further interference with the already impaired internal respiration of the cells. The trauma of the operation is divided. In cases of hyperthyroidism, if the operation produces an exacerbation of the symptoms, the operation is stopped at any point and the wound packed open with flavine or sterile gauze, closure being deferred until it is warranted by the condition of the patient. Water is urged by every route and to ensure the readiest possible hydration of the cells 3,000 cubic centimeters is routinely given daily by hypodermoclysis by Bartlett's method. Oxygenation of the cells is promoted by the transfusion of whole blood before operation, during operation, and after operation, according to the indication. To assure the maintenance of an adequate circulation—which is essential to the supply of water and oxygen to the cells, digitalis is administered routinely in those cases in which the myocardium is impaired, a condition most commonly seen in cases of hyperthyroidism. Rest and sleep are promoted by control of the environment and by narcotics, unless there is present an already depressed liver function, as in jaundice, for the function of both the brain and the liver is depressed by narcotics, especially by morphine. In abdominal cases moist hot packs are applied immediately after operation for the support of the liver cells.

The environment of the patient is controlled from the moment of his entrance to his exit from the hospital.

With the gradual extension of the application of these measures based upon the electro-chemical conception the mortality rate of every type of case has been diminished, and the operability has been extended until now no case is considered inoperable unless the stage of final dissolution is initiated.

The efficiency of any surgical method must depend upon its effects—upon (a) the postoperative mortality; (b) the postoperative morbidity. Testimony regarding the second of these points is primarily subjective and is not amenable to statistical compilations. While figures regarding the postoperative mortality demand analysis as to their relation to the various degrees of exhaustion in each patient, in the mass and over periods of years their indications are of positive value. For that reason there are included here the following mortality statistics of operations performed during the post-war period, since it was the vast experience gained in war service, not only in personal observations of wounded and exhausted soldiers, but also, and of inestimable value, in conferences and interchange of opinions with my colleagues, which has guided the later researches and the formulation of the principles in accordance with which our surgical patients are managed.

During the period from 1919 to the present date (June 21, 1923), the mortality rate of the surgical service at Lakeside Hospital has fallen from 2.4 to 1.3 per cent; the mortality rate of 1,090 thyroidectomies has been 1.8 per cent; of the last 230 of these 0.8 per cent; the mortality rate of the last 1,322 ligations has been 0.6 per cent and a series now in pro-

gress (June 21, 1923) includes 466 consecutive operations for exophthalmic goiter without a death.

SUMMARY

1. There is much evidence in support of the conception that man and animals are electro-chemical mechanisms constructed on the pattern of the constituent cells, each of which in itself is an electro-chemical mechanism.

2. In accordance with this conception—

a. Cells have the power of oxidation only as long as there is a difference in potential between the nucleus and the cytoplasm; a difference in potential is maintained only as long as there is oxidation.

b. The nucleus of the cells as compared with the cytoplasm is positive; the cytoplasm as compared with the nucleus is negative. The brain as compared with the liver is positive; the liver as compared with the brain is negative.

c. Since electricity flows from a higher to a lower potential and since oxidation in the brain is the highest, we may suppose that the oxidation electrical wave would pass down the nerves from the area of higher potential in the brain to the areas of lower potential in the muscles and glands, and since the liver has the lowest rate of oxidation—hence the lowest potential—the current would finally reach that area, whence it would return through the electrolytic system to the brain, thus completing the circuit.

3. The following facts are interpreted by the hypothesis that the body as a whole is an electro-chemical mechanism, the positive pole being the brain, the negative the liver, the connecting wires the nerves, the salts in solution the electrolytic fluid in which the electro-chemical mechanism is immersed.

a. When either pole, i.e., the liver or the brain, is removed or destroyed, the organism perishes.

b. If the difference in potential within the cells, no less than the difference in potential between the poles (the liver and the brain), is dependent on the supply of electricity by oxidation, then it follows that, if the organism is deprived of oxygen, the existing difference in potential within the cells and within the organs is lost and equilibrium, or death, is established.

c. The facts (1) that water is a non-conductor and a solvent whereby the atoms within the colloidal solutions of which the cells are composed are enabled to take on electrical charges or to become ionized; and (2) that ionization is essential for electrical communication, suggest the essential rôle of water in living processes.

d. Since the speed of chemical action and the electrical conductivity are fundamentally controlled by heat and cold, it follows that in an electro-chemical mechanism there must be an optimum temperature as well as a lethal cold and a lethal warm temperature. Abdominal surgery in the colder months in unwarmed front area huts illustrated this point by a forbidding mortality rate.

e. The opposite effects of stimulation and of exhaustion on the temperature and on the electrical conductivity of the brain and of the liver, the muscles and other tissues in the splanchnic area, would be explained by the conception that the driving power depends upon the difference in potential between the brain and the liver, muscles, and other organs. Hence, if a stimulus caused only the potential of the brain to rise and the liver remained unchanged, the difference in potential, hence the driving power, would be correspondingly less.

4. The electro-chemical theory would interpret the specific antithetic action of adrenalin upon the temperature of the brain and of the liver and other organs in the splanchnic area.

5. It would interpret the increase in electrical conductivity of the brain by iodine, iodoform, and thyroid extract (hyperthyroidism); and the decreased conductivity of the brain after thyroidectomy.

6. It would interpret the interference with digestion by the strong emotions, by injury, by pain, by infections, etc., for the splanchnic processes are inhibited while the brain is stimulated. It would interpret the antithetic effects of fear and faith, and the failure of health in man and animals under the stress of chronic fear or anger or other strong emotions.

7. This theory would suggest that the essential function of sleep is to provide a period during which, in the batteries which drive the organism, the difference in potential decreased by the activities of the day, is restored.

8. It would interpret the fact that in surgical operations, if a state of negativity and the internal respiration are maintained, there is no surgical shock.

9. The state of negativity is maintained by:

a. Exclusion of fear by management, by operation in the patient's room, by morphine, by analgesia;

b. Exclusion of traumatic stimuli by local or regional anæsthesia, by gentle handling, by protection of the wounds from the irritation of the air;

c. Exclusion of stimulation by stimulant drugs.

10. The entire process whereby the state of negativity is secured and the internal respiration—difference in potential—of the cells is maintained is included in the combination of methods of pre-operative and post-operative management and of surgical technique which is called anociation. The internal respiration is maintained by fluids, by warmth, by blood transfusion, by rest, by sleep, and by the avoidance of deep inhalation anæsthesia.

11. Finally, and included in the above, the theory that man is an electro-chemical mechanism interprets many of the phenomena of life.

EXPERIMENTS ON THE INFECTIOUS ORIGIN OF THROMBO-ANGIITIS OBLITERANS AND THE ISOLATION OF A SPECIFIC ORGANISM FROM THE BLOOD STREAM

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THROMBO-ANGIITIS OBLITERANS has long been known as the "Hebraische Krankheit," as the disease frequently occurs among Jews, as often in young adults as in the aged. Briefly, the patients complain of indefinite pains in the foot, calf of the leg, or in the toes, and rather early in the disease the coldness of the extremity is marked. One of the first symptoms to appear, long before there are any objective disturbances is the shooting, cramp-like pains in the leg, followed by evidences of erythromelalgia of the toes, trophic disturbances, and finally dry gangrene.

The well-known theories of von Winiwarter and von Manteuffel, that the obliteration of the vessel is due primarily, on the one hand, to a proliferation of the intima, and on the other, to a primary arteriosclerosis, has long been religiously adhered to, and dogmatism with its cramping tendencies crept in until Buerger published his brilliant contribution to the pathology of this disease. These findings are summarized as follows:

"Most of the larger arteries and veins of the amputated limbs were found obliterated over a large extent of their course. The obliterative process can be studied at any stage in its development, if enough vessels are examined. All stages in the occlusive change may occur in the various vessels of an extremity, or at times in the same vessel, in different parts of its course. The occlusion of the vessels is affected by red obturating thrombi; these become organized, vascularized, and canalized.

"Certain changes in perivascular tissues, in the adventitia, media, and intima, regularly accompany the occluding process. There is moderate thickening of the intima; this is never sufficient to cause marked narrowing of the lumina of the vessels, and does not seem to play any considerable rôle in the genesis of thrombotic process. The media and adventitia show cellular infiltration and vascularization wherever thrombosis has occurred. The occluding masses frequently terminate abruptly in apparently normal vessels. The changes in the media never extend into the walls of the vacant portions of the vessels; usually they terminate before the end of the obturating tissue or thrombus is reached; indeed, the dependence of the media changes upon the organization of the thrombi can be demonstrated in many places."

By a study of what Moynihan has ventured to call the "pathology of the living, that is, of morbid processes in their course rather than when their race was fully run," a very profound change has crept over our knowledge of thrombo-angiitis obliterans and other diseases of unknown origin. This was followed by another stage, the stage of combined research, in which strict, sober, clinical observation, inductive and deductive processes of reasoning, and experimental inquiry are linked together. The search for an explanation of the clinical phenomena of this disease has prompted the writer to choose the method of combined research.

After carefully observing the clinical manifestations of thrombo-angiitis obliterans, extending over a period of 10 years, the infectious origin of this disease has manifested itself in all phases of study. From May, 1922, to April, 1923, 10 cases of thrombo-angiitis obliterans were under my personal supervision, 5 of which were studied at the Beth Moses Hospital, with most extraordinary care and precision. Considerable interest was aroused as a result of certain observations, which pointed very strongly toward the bacterial origin of this disease.

First, the frequent changes in the color and temperature of the part affected, at times warm and pink, and at other times cold and

cyanotic, could not be accounted for by the occlusion of the dorsalis pedis and popliteal arteries.

Secondly, it was a common occurrence to find these patients sitting along the side of the bed, with the affected extremities hanging down, and wrapped about with various materials. This position was most comfortable for them and they even slept propped up along the side of the bed. To be sure, the circulation in the affected limb, already hampered and checked by thrombotic changes, was not aided by the lowering of the limb.

Thirdly, all 5 cases were transfused from three to four times, beginning with 250 cubic centimeters, and increased up to 500 cubic centimeters. Twenty-four hours after the transfusion, all showed a distinct line of demarcation about the gangrenous lesion, the edges of which oozed bright red blood, and the area immediately surrounding the lesion assumed a healthy pink color. Here again one perceived that the additional donor's blood reached the affected part notwithstanding the obliterated popliteal and dorsalis pedis arteries. Right here it may be well to quote Buerger: "The recent red thrombosis may involve large portions of arteries or veins and is not secondary to the gangrenous process. It occurs even when no gangrene is present." The formation of gangrenous lesions, therefore, seemed to be independent of the extent of thrombosis and occlusion of vessels.

Fourthly, 48 hours after the transfusions, all 5 patients complained bitterly of an increase in the pain and burning of the affected parts, and on close examination gangrene which had been limited to the toes, had spread about 2 inches up the anterior surface of the foot. Since the blood supply to the affected parts was improved immediately after transfusions, the aggravation of symptoms 48 hours after transfusion called for an explanation.

Fifthly, about 5 days after the transfusions, all 5 cases developed a vesicular rash over the anterior and posterior surface of the foot. The majority of these vesicles were pin point in size, though some were slightly larger. On pricking these vesicles, they were found to be devoid of fluid, but, being under tension, probably contained gas. Cultures from these vesicles proved to be sterile. I have since observed these pin-point vesicles in 5 other authentic cases. They are usually found in the apparently unaffected skin adjacent to the lesions, and are quite characteristic in this disease.

The following deductions have been assumed:

1. The gangrenous lesions are not merely the result of mechanical obstruction but are due to some other agent which has a direct action upon the local tissues as well as its blood supply. Buerger states: "The intensity of the cellular and vascular change seems in general to depend upon the activity of the organization of the clot; however, in some cases it seems to be sufficiently marked to make it appear that the same agent which calls forth the coagulation of the blood is also effective in producing the mesarterial lesion."

2. That the pain and burning is not due to thrombosis with its resulting stasis, since they seem to be relieved in the position that helps to produce venous stasis. Another agent seems to be responsible for the aforesaid symptoms.

3. The experimental production of an extension of the local lesion by the addition of fresh donor's blood 48 hours after its injection, seemed to point a suspicious finger at some agent which was activated by fresh blood elements. As to what causes this extensive thrombosis of the veins and arteries, Buerger was inclined to believe that mechanical conditions, such as slowing of the circulation and arteriosclerotic changes, may be factors, but that some *additional agent*, be it toxic or otherwise, must be at the same time responsible.

4. The appearance of an abundance of gas-filled vesicles 5 days after transfusion seemed to be directly related to the addition of a fresh supply of blood.

Certain organisms have long been known for their special affinity for blood elements and, working along these lines, I have attempted to isolate an organism from the lesion produced in this disease, followed by the usual chain of failures. I have finally decided that it was not due to the absence of a specific organism, but rather that the method of seek-

ing it at its habitat was at fault. The following procedures were therefore carried out in order to prove this contention.

First Stage

On my service at the Beth Moses Hospital, a given case of actually proven thrombo-angiitis obliterans, with a lesion of the great toe and obliterated dorsalis pedis, accompanied by the usual symptoms of pain, burning and objective symptoms of the part affected, was selected. Three leeches were applied to an aseptically prepared ankle of the affected limb. The blood from these leeches was immediately extracted, centrifuged in sterile test tubes, and incubated. The hæmolyzed serum was then removed and about 5 drops injected subcutaneously into an apparently healthy portion of the calf of the affected limb. After 48 hours, the usual signs of inflammation appeared, over a considerable area, surrounding the site of injection. This was followed by a peculiarly purplish hue. One week after the injection, an area of superficial gangrene appeared about 2 inches below the needle puncture. This area of gangrene had a sharp line of demarcation (Fig. 1); the longest diameter being about 2 centimeters in length, longitudinally placed, with a transverse diameter of about 1 centimeter. Two weeks after the first injection, signs of fluctuation above the area of gangrene, were elicited. This area was incised and the sanguineous pus examined bacteriologically, and cultured in the laboratory of the Beth Moses Hospital. Sub-cultures were made, and due to lack of facilities for animal experimentation the work was transferred to my laboratory for further investigation.

Fig. 1. Gangrenous lesion in calf of leg.

Differential Characteristics of the Organism Isolated

This organism is a gram negative, aerobic, facultative, anaerobic, freely motile bacillus, medium sized, rod shaped and beaded, bipolar in appearance, containing metachromatic granules (Fig. 4), measuring about five-tenths of a micron in diameter and from five-tenths to one micron in length. It forms no capsules and produces no spores. Flagellæ have not been demonstrated. They stain readily with ordinary aniline dyes, though not intensely, and grow on the ordinary media but most luxuriantly on Loeffler's media. The organism ferments glucose, saccharose, and mannitol, producing gas and acid reaction, but does not ferment lactose. The indol reaction on sugar-free broth is negative. On agar, the colonies are scanty, raised, and smooth, rather translucent, colorless, and round, with a sharp border. After 24 hours' incubation at 37° C. the colonies attain a diameter of about one-half millimeter. In broth, there is a uniform clouding, a characteristic cadaveric odor, and a moderate flocculent sediment. In gelatin stab, the growth is filiform along the line of puncture. Liquefaction begins on the sixth day and terminates about the twelfth day. On Loeffler's blood serum the growth is glistening and abundant, and liquefaction begins on the third day. The organism grows best at 37° C., maximum temperature 50° C., minimum at 20° C.

On account of the anticoagulative and hæmolytic tendencies of herudin (the active principle of the heads of leeches) leeches were utilized for further experimentation.

I. Leeches were applied over the ankle of the apparently normal skin of the affected limb, the blood extracted and emptied into a sterile test tube, centrifuged, and incubated. The pink hæmolyzed serum (a few drops) was injected into the inner surface of the right ear of Rabbit 1.

II. Leeches were applied over the vein of the elbow of the same patient and the blood extracted and emptied into a sterile test tube containing 2 per cent citrate solution centrifuged, incubated, and the hæmolyzed serum injected into the inner surface of the right ear of Rabbit 2.

III. Ten cubic centimeters of blood was drawn (per syringe) from the vein of the other elbow and emptied into 2 per cent citrate solution, incubated, and centrifuged. The clear non-hæmolyzed serum was then injected into the left ear of Rabbit 1 as a control. The fields of operation were all prepared under the most rigid asepsis.

Three days later, the vessels of the right ears of Rabbits 1 and 2, injected with hæmolyzed serum (derived from the diseased ankle and the unaffected elbow of the patient), were considerably dilated. One week later the smaller vessels about the site of injection were completely thrombosed, and, at the end of 10 days, a gangrenous area, with its long axis parallel to the length of the main vessel, with a sharp line of demarcation, appeared in the right ears of both Rabbits 1 and 2. A very scanty grayish discharge could be squeezed out from underneath the sharply defined border of these gangrenous lesions. All about these lesions there was an area of purplish discoloration, characteristic of venous thrombosis. Cultures made from these lesions showed a gram negative, freely motile bacillus, with the same cultural characteristics as that of the bacillus isolated from the lesion produced in the calf of the leg of the given patient.

The left ear of Rabbit 1 which was injected with the clear non-hæmolyzed serum, derived from the blood of one of the veins of the elbow as a control, showed no lesion whatsoever, not even engorgement of the vessels.

A bouillon culture of this bacillus derived from the lesion of the rabbit's ear was injected into both ears of Rabbit 3, and 3 days later a terrific engorgement of the vessels of the ears appeared, with considerable thrombosis and purplish discoloration. After 10 days, several areas of ecchymoses appeared, but no gangrenous area resulted.

Several leeches were then applied to the veins of the elbow of a normal human being and the blood extracted, emptied into 2 per cent citrate solution, centrifuged, incubated, and both, the serum and the solid contents of the blood, cultured. These cultures proved to be sterile. The sterile hæmolyzed serum was then injected into both ears of Rabbit 4 and no lesion appeared at the end of 10 days.

A subculture from broth was then transferred to a Loeffler's media to which had been added several loopsful of the sterile solid contents of blood drawn from the vein of the normal human being under the most aseptic precautions. After 24 hours' incubation, a loopful of this culture was immersed in several drops of sterile saline, and the suspension injected into the left ear of Rabbit 4. Several drops of a fresh bouillon culture were injected into the right ear of the same rabbit. After 5 days, considerable engorgement of the vessels of both ears was quite evident, accompanied by a purplish hue and an increase in the temperature of the local part. On the eighth day, the right ear injected with the bouillon culture, showed no additional changes, whereas the left ear injected with a saline dilution of a culture derived from Loeffler's media, to which had been added the solid contents of blood derived from the vein of a normal human being, showed the following: A gangrenous area, about 1 centimeter long and 0.5 centimeter wide, situated at the base of the ear and typical of the lesions produced in the Rabbits 1 and 2.

About 4 weeks after the inoculation of a pure culture of this organism into the ears of Rabbits 1, 2, 3, and 4, gangrenous lesions appeared on the plantar surfaces of the feet of Rabbits 1, 3, and 4, near the heels and at points corresponding to the great toes, analogous to those seen in thrombo-angiitis obliterans. On and about the time of the appearance of the lesions on the feet, Rabbits 1, 2, 3, and 4 fed poorly and were wont to huddle up near the stove, as though they tried to keep warm. They took on a peculiar gait, and moved about on their knees, so as to protect the plantar surface of the feet from pressure. Sections of the lesions and blood supply of the thigh, leg, and feet showed some very interesting findings similar to those found in the vessels of patients suffering from thrombo-angiitis obliterans (Figs. 5, 6, 7, 8, and 9). In Rabbit 3, no lesion appeared in the ear after inoculation, but the typical lesion appeared on the left foot, which phenomenon proved the tissue predilection of this organism. The bacillus was isolated in pure culture from the gangrenous lesions on the plantar surfaces of

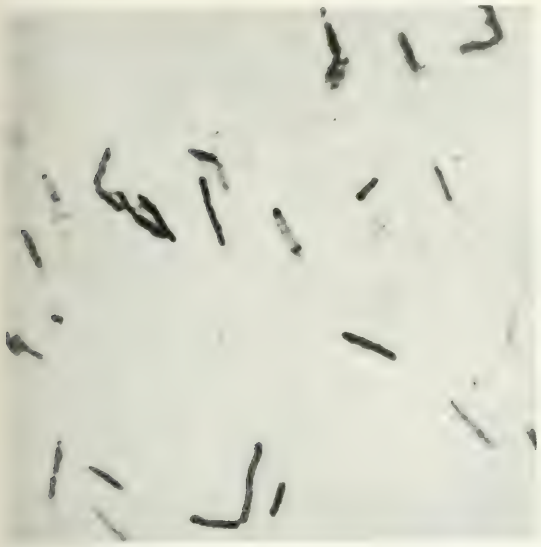

Fig. 2. Organism isolated from the blood stream of thrombo-angiitis Case 3. Note the bipolar metachromatic granules.

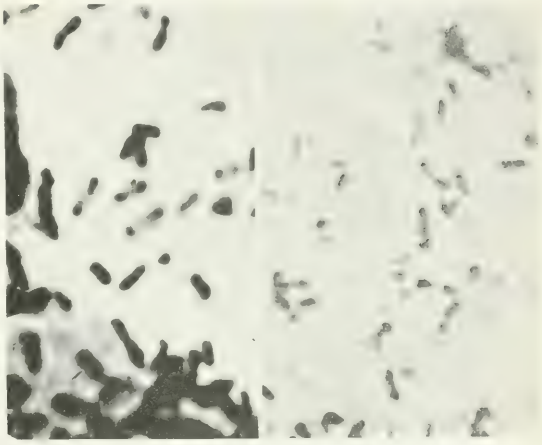

Fig. 3. Organism isolated from the lesion produced in the rabbit's foot. Note the bipolar metachromatic granules.

Fig. 4. Organism isolated from the lesion produced in the calf of leg of Case 1. Note the bipolar metachromatic granules.

the feet of Rabbits 1, 3, and 4 (Fig. 3). Rabbit 2 died 3 weeks after inoculation and though no gross lesion appeared on the feet, microscopic sections showed early thrombosis of the vessels (Fig. 5). In all three rabbits, the lesions appeared on the left extremity, a peculiarity of distribution similar to that observed in thrombo-angiitis obliterans.

Second Stage

From these experiments, one readily notes that the organism grows most favorably in the presence of hæmolyzed blood (blood hæmolyzed by the herudin of the leech) and is activated by the solid contents of blood. An area of skin over the ankle of the affected limb was aseptically prepared and one of the veins punctured. Blood was caught in a sterile test tube containing about 1 cubic centimeter of sterile distilled water, thus making about 3 cubic centimeters in all. After shaking the contents, it was allowed to incubate about 4 hours at the room temperature, so as to effect as nearly a complete hæmolysis as is possible and thus substitute the action of herudin. The contents was then emptied into a sterile bouillon media under the most rigid aseptic precautions and allowed to incubate for 24 hours. The organism derived from this culture was morphologically identical with that of the original organism described, and its cultural characteristics similar in every way. Two other cases suffering with thrombo-angiitis obliterans had submitted themselves for blood culture from the local area, and executed in the same fashion. The organism described proved positive in both.

Third Stage

The same three cases of thrombo-angiitis obliterans and two additional ones were then subjected to the following procedure: The bend of the elbow was thoroughly cleansed with soap and water, followed by a bichloride compress, dried with sterile gauze and painted with iodine, which in turn was washed off with alcohol and dried. A needle previously sterilized in the autoclave was inserted into the median basilic vein and under the most rigid aseptic precautions, 10 cubic centimeters of blood was drawn into a sterile syringe (sterilized in the autoclave) and half of it injected into a sterile bottle containing sterile distilled water and beads. The other half was emptied into a sterile bottle containing beads. Both were shaken for 5 minutes and then emptied into agar media, after being cooled off to a temperature of 42° C., and this in turn emptied into sterile petri dishes in the form of a blood

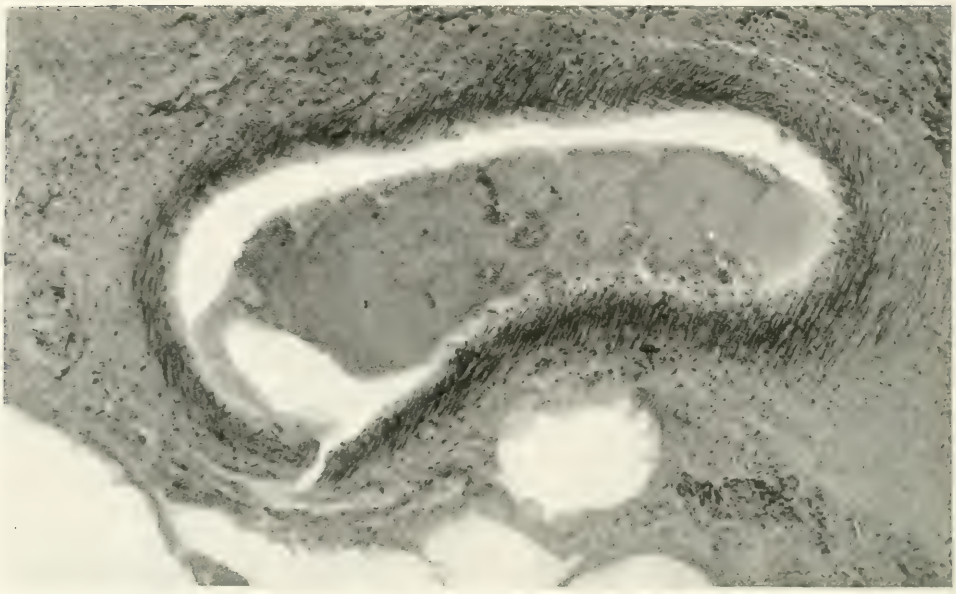

Fig. 5. (Rabbit 1.) Obliterating thrombus with beginning organizing of clot adherent to intima.

Fig. 6. (Rabbit 3.) Organized thrombus within blood vessel canalized by clefts. Note the capillary sprouts to the right.

agar plate. In all 5 cases a positive culture was obtained on the agar plates containing hæmolyzed blood, after 48 hours' incubation. The colonies, though not abundant, took on a brownish discoloration surrounded by a lighter area of hæmolysis and attained a size of from 0.5 to 1 millimeter. From these colonies, hanging drops were made and studied for motility and then stained. Cultures from these colonies were transferred to Loeffler's

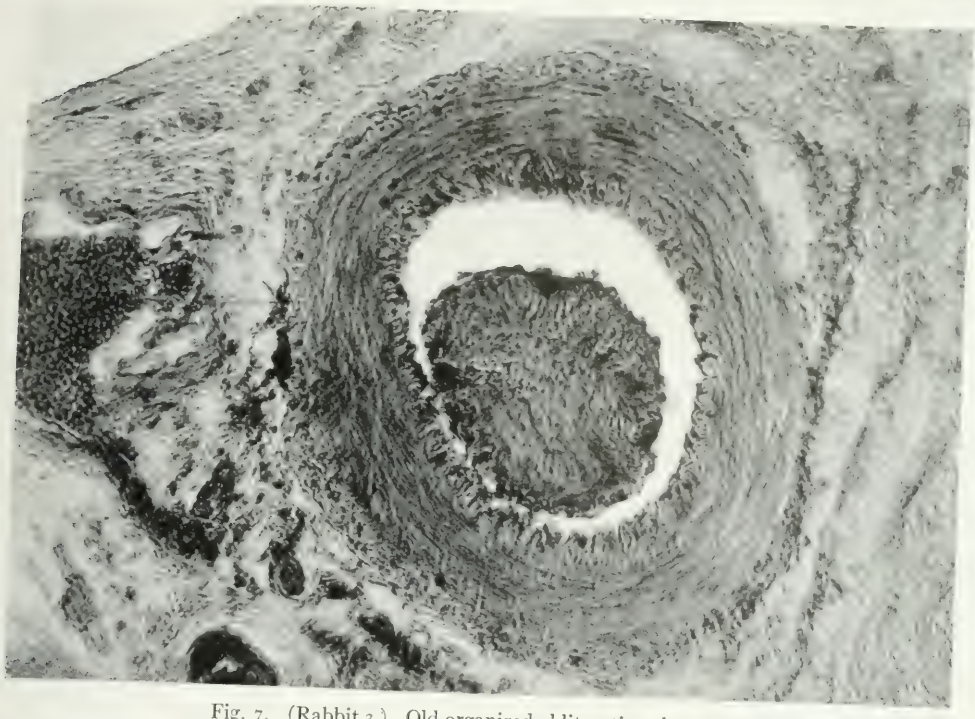

Fig. 7. (Rabbit 3.) Old organized obliterating thrombus.

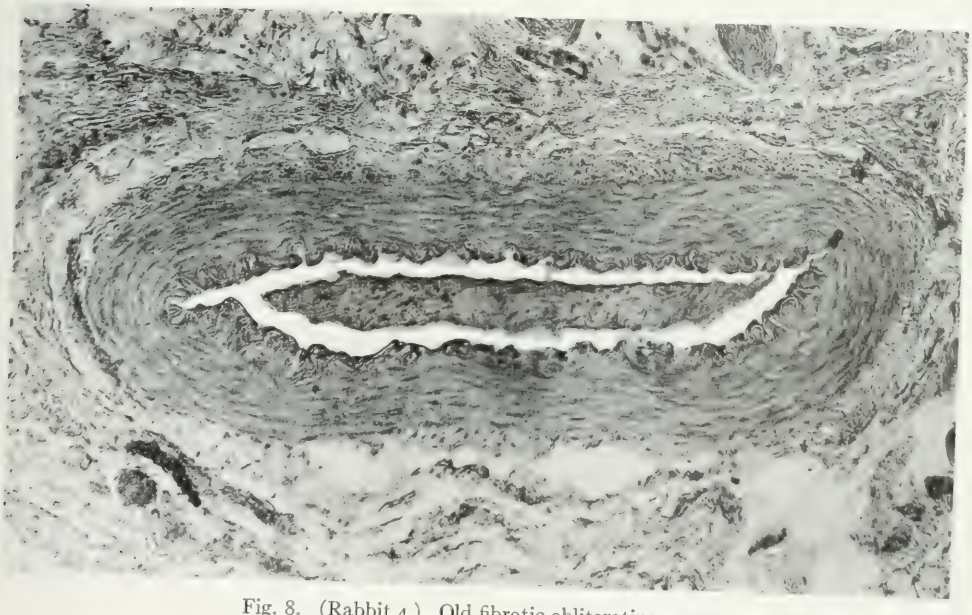

Fig. 8. (Rabbit 4.) Old fibrotic obliterating mass.

tubes, glucose agar slants and agar plates, also glucose, lactose, saccharose, and mannitol broth and their cultural characteristics noted.

In all these, the organism was identical, both morphologically and culturally, to that described in the original experiment in Case 1

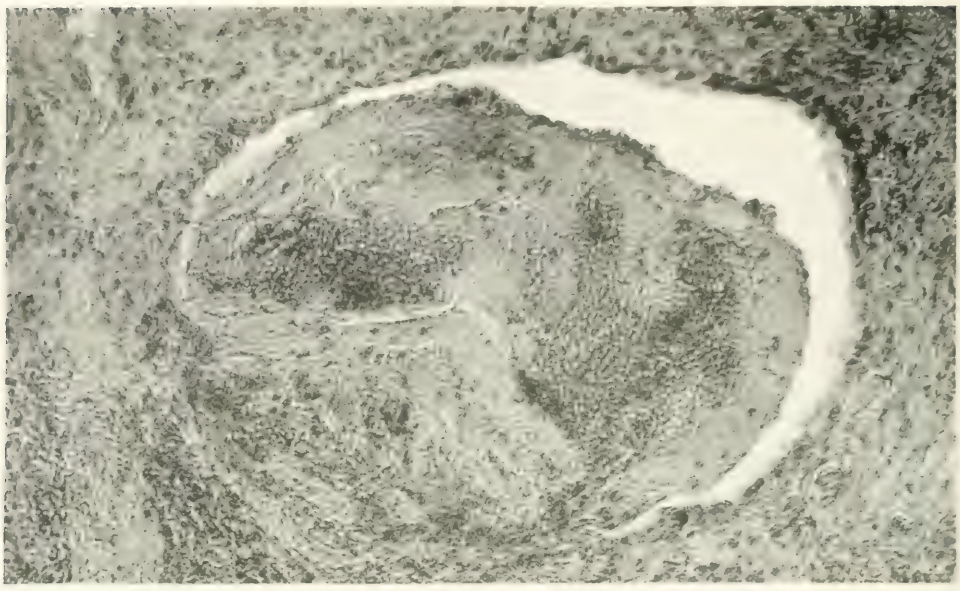

Fig. 9. (Rabbit 4.) Note the organization, vascularization, and canalization.

(Fig. 4). A pure culture of this organism derived from the blood of Case 4 injected into the inner surface of the ear of a rabbit produced a gangrenous lesion identical to that described in Rabbits 1, 2, and 4. The lesion appeared 7 days after inoculation, and further investigation as to remote lesions at a later date will be reported.

CONCLUSIONS

The following conclusions have been arrived at, to be checked up by additional blood cultures:

1. The bacillus isolated produced the same lesion in the ears and feet of the rabbit as that which was present in the calf of the leg of the human being.

2. The lesions produced were similar in their gross and microscopic pathology to that produced in the disease known as thromboangiitis obliterans.

3. This bacillus was isolated both from the blood of the local affected portion and from the general blood stream.

4. The organism was distinctly hæmaglobinophilic.

5. The bacillus could not be isolated from the body of the leech, therefore eliminating the normal habitat of this organism within the leech.

6. Normal hæmolyzed serum (per leech) produced no lesion in the rabbit's ear. The bacillus was therefore responsible for the production of the gross lesions.

7. The clear non-hæmolyzed serum derived from the unaffected veins of the elbow in the specified case, produced no lesion in the rabbit's ear. May I venture this explanation: that the bacillus requires hæmolyzed blood for cultivation and isolation from the blood stream.

8. Though a bouillon culture produced considerable reaction in the ear of Rabbit 4, the culture containing the solid content of blood, activated the bacillus sufficiently to produce a typical gangrenous lesion in the other ear of Rabbit 4.

9. The appearance of lesions on the plantar surfaces and toes of three rabbits, 5 weeks after inoculation, showed conclusively the entrance of this organism into the general blood stream and, furthermore, a specific tissue predilection.

10. The organism isolated in pure culture from the blood of Case 4 produced a similar gross lesion in the rabbit's ear.

I. FIBROMYOMA OF THE EPIDIDYMIS II. PARAFFINOMA OF THE PERITESTICULAR TISSUES[1]

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THE two cases which I desire to call to your attention are of interest, the one by virtue of its extreme rarity, the other by reason of its unusual location.

I. FIBROMYOMA OF THE EPIDIDYMIS

In a diligent search of the literature I was unable to find record of any solid tumor of the epididymis, with the exception of a case reported by Stout before the New York Pathological Society and published in its *Proceedings* for 1917. His case, however, is that of a small tumor of the epididymis, a trifle over 1 centimeter in diameter. The pathology is reported as that of a fibromyoma, but was first diagnosed as an adenocarcinoma. The patient was a carrier of a primary carcinoma of the gall bladder. This case must be regarded as a doubtful one of fibromyoma.

Winiwarter in volume iii of the *Handbuch der Urologie* quotes Wilms as stating that myomata, both leiomyoma and rhabdomyoma of the testis, may occur and that they have their origin in the so-called cremaster internus, in the muscular sheath of the epididymis, or in the gubernaculum testis. This reference is the only allusion in the entire literature which was at my command as to the possible histogenesis of these tumors. No other reference was found to any primary or metastatic solid tumor of the epididymis. I have asked several pathologists in this city for references or possible reports of cases personally observed and they have not been able to recall any.

Our patient was a man, age 65, admitted to the Michael Reese Hospital to the service of Dr. Kolischer February 23, 1920; No. 16213. He complains of a hernia of left inguinal region and a swelling of left testis. The hernia had been operated upon 2 years before (1918) with subsequent recurrence. The swelling within the left side of scrotum began after the herniotomy in 1918, and has steadily increased to its present size. The tumor is painless but, on account of its weight and the "dragging" sensation produced, gives the patient much discomfort when he walks.

The patient's father died at 60, cause unknown; the mother is alive and well; three children are living and well; six children died in infancy or childhood, cause unknown.

Patient's appetite is good; bowels are only fairly regular. He sleeps well and has no difficulty in urination.

Patient had a herniotomy performed 2 years ago; had grippe 3 weeks before entrance.

General physical examination reveals a man in good condition for his years. Findings are negative except for a moderate left inguinal hernia and a tumor within the left half of the scrotum. What is apparently the left testis is felt as a tumor the size of a large goose egg. Its consistency is hard, and there is no tenderness on palpation. Light is not transmitted through the tumor. One is impressed by the marked heaviness of the organ. The tumor ends abruptly at its upper margin and the globus major of the epididymis seems to be involved.

Tentative diagnosis: tumor of left testis, probably malignant.

The Wassermann reaction using cholesterinized, lipoid and syphilitic antigens was frankly negative.

Operation. A typical castration of the left testis and epididymis, with high amputation of the cord, was done. A hard nodule the size of a small almond was palpated in the tissue of the spermatic cord. This nodule was of the same consistency as the larger tumor.

The patient made an uneventful recovery and left the hospital well on the sixth day of March. The specimen was immediately sent to our pathologist, Dr. O. T. Schultz, to whom I am indebted for the pathological report.

Gross pathology. The specimen is 9 centimeters long and 4.5 centimeters in diameter. A small amount of fluid is present beneath the tunica vaginalis. The testis is a sharply defined, encapsulated mass at the lower pole of the specimen; its cut surface is 4 by 1.5 centimeters. Above the testis the epididymis is transformed into a mass of dense, firm, pale, somewhat lobulated tissue, the cut surface of which measures 4 by 4.5 centimeters. At the upper pole the tissue of the cord contains a nodule of similar appearance.

Microscopic examination. The mass is composed in places of bands and large areas of fibrous tissue, which is dense, hyaline, and poor in nuclei; in places this tissue is œdematous. Between the islands and bands of fibrous tissue are more cellular areas, some of which are composed of closely placed, elongated,

[1] Read before the Chicago Urological Society, January 25, 1923. From the Department of Genito-Urinary Surgery and the Nelson Morris Memorial Institute for Medical Research of the Michael Reese Hospital.

Fig. 1. Fibromyoma of the epididymis, approximately natural size. Note the testis displaced and compressed at the lower pole of specimen.

spindle cells of the smooth muscle type. These are usually arranged in interlacing bundles. Other cellular areas are made up of shorter, broader cells, many of which have giant, hyperchromatic, single or multilobulated nuclei. These cells have the characteristic morphology of proliferating smooth muscle cells; the immaturity and cellularity of these islands of tissue are such as to raise a suspicion of beginning malignancy. The more cellular tissue in places is diffusely infiltrated by considerable numbers of lymphocytes. In some of the denser fibrous tissue the small vessels are surrounded by narrow zones of lymphoid infiltration. The mass is covered by a rather thick capsule of dense fibrous tissue. Beneath this are scattered islands of cellular infiltration, composed of lymphocytes and plasma cells which surround newly formed blood vessels. No tubules and no heterologous elements are seen anywhere in the tumor tissue. Outside the capsule are large blood vessels, adipose tissue, and muscle bundles.

Diagnosis: fibromyoma of epididymis.

The patient is at present alive and well with no recurrence of the lesion.

We have, therefore, under consideration a solid tumor of the epididymis which microscopically is benign and which after 23 months has shown no tendency to recur or metastasize, a fibromyoma. The histogenesis of the tumor is not absolutely certain, but in all probability is from the muscular elements of the epididymis.

From the clinical side, the tumor was not differentiated from a new-growth of the testis and the actual testis was mistaken for globus major of the epididymis. As far as the writer is able to determine, this is the first tumor of its kind on record.

II. PARAFFINOMA OF THE PERITESTICULAR TISSUES

A paraffinoma is a foreign body granuloma produced by an unabsorbable oil. Most of those reported, and the number has been quite large, occurred in the tissues of the face, paraffin having been injected by quack cosmetic doctors with the idea of obliterating blemishes of various kinds. The pathology of this entire group is very similar, in fact, almost constant. Paraffins having melting points between 55 degrees and 65 degrees C. are most often used.

Heidingsfeld found the epidermis to be normal. The affected area was encapsulated in a wall of fibrous connective tissue. Near the center was usually one, sometimes several, large cavernous spaces, which were surrounded in satellite form by innumerable small round cavities of similar character, giving the area a sort of honeycomb appearance, not unlike that presented by a well-aerated piece of Swiss cheese. The remainder of the mass resembled in its general appearance a granuloma; showing a variable number of giant cells.

Our patient was a young man, M. R., age 22 years, a clerk by occupation. He was admitted to Michael Reese Hospital to the service of Dr. L. E. Schmidt on April 5, 1921; No. 26712. Patient com-

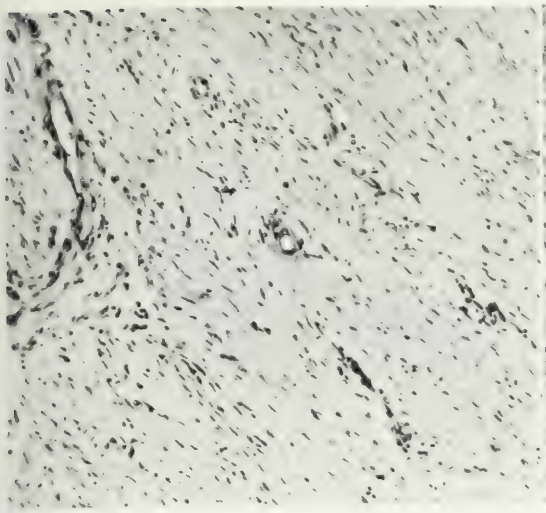

Fig. 2. Section of fibromyoma of epididymis showing the more fibrous part of tumor which is poor in nuclei. ×110.

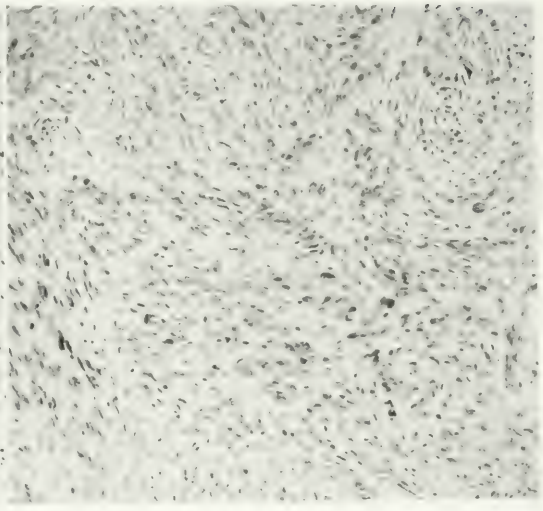

Fig. 3. Section of fibromyoma of epididymis showing large spindle-shape nuclei characteristic of immature or proliferating smooth muscle cell. ×110.

plains of swelling within the scrotum and pain in right leg. In 1918 while in a hospital in Russia, suffering from typhoid fever, some oil was injected into his scrotum. The patient states that this was done by mistake, the injection having been intended for another patient in the ward. Following this injection (interval not stated) the scrotum began to swell, and there was some pain. Since then the condition has gotten progressively worse. Pain in right thigh when walking began a year ago; and it is largely for this reason that patient enters hospital. When he rests there is no pain felt.

Patient has had the usual diseases of childhood and typhoid fever 3 years ago. He had not been operated upon for any condition. Patient denies all venereal disease.

Patient's father died of some renal disease; the mother living and well; one brother is living and well. There is no family history of tuberculosis, carcinoma nor organic heart disease.

General physical examination. The patient is a well-nourished young man apparently 21 or 22 years of age. He is highly neurotic, and ill at ease in his surroundings. He cannot speak nor understand English and cannot speak any of the foreign languages which the house staff commands. Communication was through an interpreter. There is a marked accentuation of all the reflexes. With the exception of the lesion within the scrotum and a right inguinal hernia, special physical examination is negative.

The penis is negative for scar and discharge. There is a hard, smooth tumor mass within the scrotum, the size of a lemon, which does not, however, involve either testis, as these organs can be distinctly differentiated from it. The normal testicular consistency is noted on palpation as well as the characteristic pain when the testes are compressed between thumb and index finger.

Laboratory examinations of urine and blood were negative. The Wassermann reaction was negative with all three antigens.

Operation. An incision was made in the right anterior surface of the scrotum, and a hard solid tumor intimately attached to the tunica vaginalis of the right testis and epididymis, and infiltrating all the enveloping tissues, including the derma, which were with difficulty dissected away from the testis and epididymis, entirely sparing these structures. The infiltrating tumor mass including a narrow strip of skin was removed. The wound was sutured with interrupted silk sutures and gutta percha drainage left in the lower angle of the wound. The hernia was repaired according to the typical Bassini technique.

The pathological report by Dr. O. T. Schultz is as follows:

Gross specimen. An irregular mass 7 by 7 by 4 centimeters composed of a main ovoid portion 6 by 3.5 by 3.5 centimeters, to one surface of which a piece of skin 6 by 1.5 centimeters is closely adherent. This mass is very firm, yellowish grey, with a central cavity 1 centimeter in diameter. It is well defined and is covered by a closely adherent fibrous capsule. Attached to this larger mass is a second, firm, flattened mass 3.5 centimeters in diameter and 1.5 centimeters thick. This likewise is yellowish grey in color, but is not sharply defined and is surrounded by a thick layer of dense fibrous tissue. Attached to the latter is a flattened cord-like structure 4.5 centimeters long by 3 by 1 centimeter. This contains two small hard nodules.

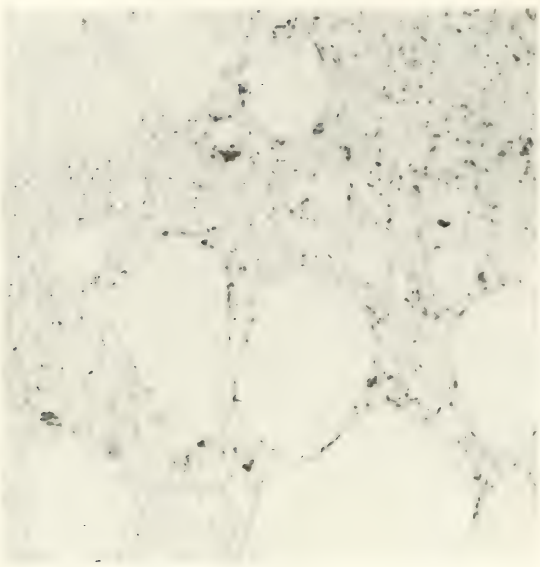

Fig. 4. Paraffinoma of peritesticular tissue, showing numerous cavernous spaces separated by narrow stroma bands. Note also giant cells in connective tissue of granuloma type. ×110.

Microscopic examination. Sections from the main mass, the large accessory nodule, and the small nodule in the cord-like structure are all similar. Areas of varying size are made up of groups of clear spaces which are separated from each other by narrow stroma bands. These areas have the appearance of adipose tissue, but the spaces are larger and vary more in size than those of normal fat. These areas are scattered about irregularly in a very dense, hyaline fibrous tissue which is poor in nuclei. In this tissue are a few scattered, sharply defined bundles of elongated fibers which have the appearance of smooth muscle. In the tissue made up of the clear spaces there are a few small collections of lymphocytes. A few of the spaces are partly surrounded by multinucleated syncytium of the foreign body, giant-cell type. There is no active proliferation and nothing to cause any suspicion of malignancy.

Diagnosis: foreign body granuloma of peritesticular tissue (due to unabsorbable oil).

This case is detailed chiefly because in the writer's memory no such case has been reported before this society and to call attention to the severe, if not serious, reaction which may and not infrequently does follow the injection of unabsorbable oils into the body. In the latter sense, it has a bearing on the selection of vehicles for the exhibition of insoluble mercurial preparations in the treatment of syphilis.

To the dermatologist these lesions are by no means rare but they should not be the only ones to be familiar with the condition. The diagnosis in the presence of a good history is easy and the only treatment is surgical ablation.

THE ETIOLOGY AND IMPORTANCE OF THE CYSTICO-DUODENO-COLIC FOLD[1]

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CERTAIN congenital anatomical variations in the peritoneal relations of the gall bladder have not received the attention they deserve from the anatomist, clinician, or surgeon; I refer to folds occasionally found extending from the fundus of the gall bladder to the duodenum and transverse colon.

Standard anatomies dismiss these ligaments with a few words or fail to mention them. Figure 1 (Spalteholz) shows the usual anatomical relations in the gall-bladder region. Spalteholz says that there is often a fold from the under surface of the gall bladder to the descending part of the duodenum or the transverse colon. Cunningham speaks of an occasional fold passing from the region of the gall bladder to the transverse colon and right colic flexure. Piersol says that the lesser omentum is sometimes described as being prolonged across the first part of the duodenum to the transverse colon, fusing there with the great omentum, and he adds that while common, this is only an accidental finding. He also describes an accessory fold, the duodenocystic ligament, which is prolonged to the right from the front of the lesser omentum in the region of the cystic duct and gall bladder.

Testut and Belou describe and illustrate the ligament as extending from the superior border of the transverse colon to the upper extremity of the gall bladder. Henle, among the older anatomists, gives a somewhat diagrammatic picture of a ligament extending up over the liver and fundus of the gall bladder and reaching down as far as the transverse colon, but he does not describe it in his text. Deaver also illustrates, but does not describe, the ligament. Toldt pictures an unusual fold in the body of an infant, 3 weeks old, in which the ascending and transverse colons had failed to adhere to the posterior abdominal wall, the ligament in question extending from the gall bladder to the parietal peritoneum to the right of the ascending mesocolon. Morris discusses peritoneal folds in general and says that variations due to extensions of normal developmental processes are difficult to distinguish from pathological adhesions. Kehr quotes Konjetzny as drawing attention to a ligament binding together the transverse colon and gall bladder. Konjetzny ascribes more or less importance to it and asserts that it may produce symptoms simulating gall-bladder disease sufficiently severe to justify operation. He adds that, while congenital in origin, it may become secondarily indurated from purely mechanical causes, as, for example, tension caused by a sagging transverse colon. Kehr says that these bands are merely a widening of the hepatoduodenal ligament, and are of very little importance.

The accessory folds that I found are prolongations of the lesser omentum onto the under surface of the gall bladder, extending to the right across the duodenum and downward to the transverse colon where they become continuous with the anterior layer of the great omentum. In order to understand their anatomical relations and possible variations, it is essential to trace their mode of formation in the embryo.

In human embryos of about 6 weeks the intestinal tract consists of a partially differentiated tube suspended in the cavity of the body throughout its entire length by a dorsal mesentery, and a ventral mesentery which divides the upper portion of the cavity and ends in a free margin extending from the region of the umbilical cord to the juncture of the fore and mid gut. Just below the free attachment of the ventral mesentery is the primary intestinal loop, in the lower limb of which the cæcum develops. The liver, gall bladder and ducts develop between the folds of the ventral mesentery from outpocketings of the foregut (Fig. 2). The portion of the

[1] Work done in the Section on Pathologic Anatomy at the suggestion and under the direction of Dr. H. E. Robertson.

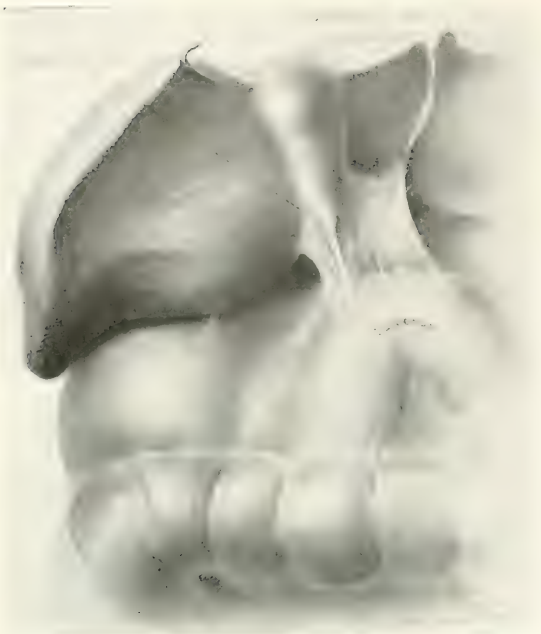

Fig. 1. Normal peritoneal relations of the gall bladder. (Spalteholz.)

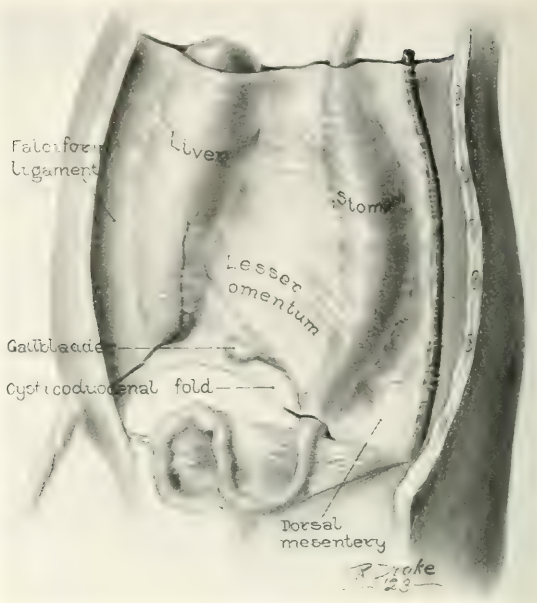

Fig. 2. Semidiagrammatic drawing showing the development of the liver, gall bladder and ducts within the folds of the ventral mesentery, and illustrating the formation of the cystico-duodenal fold. (Modified from Kollmann.)

ventral mesentery lying between the liver and stomach becomes the lesser omentum while the fold between the liver and anterior abdominal wall forms the falciform ligament. The lesser omental sac is represented in 3 millimeter embryos by a small pocket extending into the dorsal mesentery to the right of the œsophagus. A longitudinal ridge makes its appearance to the right of the opening of this sac along the dorsum of the body cavity, the plica vena cava, in which the vessel of that name develops. The liver grows rapidly in three planes and, spreading the leaves of the ventral mesentery apart, forms a crescent on cross section, the right free margin of which with the plica vena cava forms a partition between the lesser omental sac and the peritoneal cavity. In 5 to 10 millimeter embryos the omental bursa is semilunar in cross section and is bounded on the left by the great omentum (dorsal mesentery) and right wall of the stomach, on the right by the liver and the plica vena cava, and ventrally by the lesser omentum (ventral mesentery). The bursa communicates with the peritoneal cavity through an opening between the liver ventrally and the plica vena cava dorsally, the future foramen epiplocium (Fig. 3). The stomach now rotates in two directions; clockwise on a fulcrum lying anteroposteriorly, bringing it nearly to a transverse position, and on its longitudinal axis so that the former left wall becomes its anterior, and the right wall its posterior surface. The lesser peritoneal sac now lies under the stomach and that part of the dorsal mesentery which formed its left boundary continues to grow out over the transverse colon, at first as an open pocket which later closes by fusion of its two contiguous surfaces, then becoming adherent to the transverse colon to form the great omentum (Fig. 4). With these changes there is rotation of the small and large bowels, the cæcum traveling from the lower left quadrant across the duodenum to the upper right quadrant directly under the right lobe of the liver, then slowly descending to its normal adult location near the brim of the pelvis. The small intestine rotates around the superior mesenteric artery as an axis, and its mesentery becomes attached to the posterior abdominal wall along a line extending diagonally

from above downward and from left to right. The duodenum, the ascending and descending colons fuse with the posterior abdominal wall, their mesenteries becoming obliterated, the condition found in the adult (Figs. 5, 6, 7 and 8). The lesser omentum now lies on a coronal plane, its anterior layer being continuous over

TABLE I.—MAYO CLINIC CASES

Case	Age, sex	Data from cases	Other congenital abnormalities
A304079	40 M	Malignant osteoma of left parietal bone.	
A400979	M	Stillborn, eight months, cleft palate, harelip, patent interventricular septum, mobile cæcum and ascending colon; webbed fingers of left hand, hypospadias.	See Column 3
A400507	31 M	Chronic aortic and mitral endocarditis with cardiac dilatation and hypertrophy; foramen of Winslow closed.	
A401367	33 M	Fractured skull (suicide).	Meckel's diverticulum.
A403207	37 M	Diphtheria, œdema of larynx and lungs.	Cæcum in right upper quadrant
A399664	50 F	Hyperplasia and adenoma of the thyroid, cardiac hypertrophy.	
A208764	56 F	Recurrent exophthalmic goiter with cardiac hypertrophy and dilatation.	
A394327	45 M	Chronic myocarditis with hypertrophy and dilatation.	
A333504	45 F	Myelogenous leukæmia, splenomegaly, hæmorrhage into left cerebrum; foramen of Winslow closed.	
A392722	32 F	Exophthalmic goiter, thyroidectomy, cardiac hypertrophy.	
A119472	30 M	Malignant papilloma of bladder, cystitis, and pyonephrosis.	Accessory spleen.
A404586	45 M	Exophthalmic goiter, thyroidectomy, bronchopneumonia with multiple abscesses.	
A405083	38 F	Cystic glioma of left frontal lobe, terminal pneumonia; foramen of Winslow closed.	
A354664	48 M	Ulcerating squamous-cell carcinoma of face and neck.	Accessory pancreas in jejunum.
A412491	F	Prematurity, 8 months, partial fetal atelectasis, punctate hæmorrhage in pia arachnoid.	
A367384	60 M	Carcinoma of prostate, septic infarcts of lungs, early bilateral empyema, cysto-uretero-pyelonephritis, septic jaundice.	
A410558	4 F	Glioblastoma of the right eye, enucleation.	
A412224	74 M	Coronary sclerosis with myocarditis, cardiac hypertrophy and dilatation.	Diverticulum of duodenum, short mesentery to ascending and descending colons

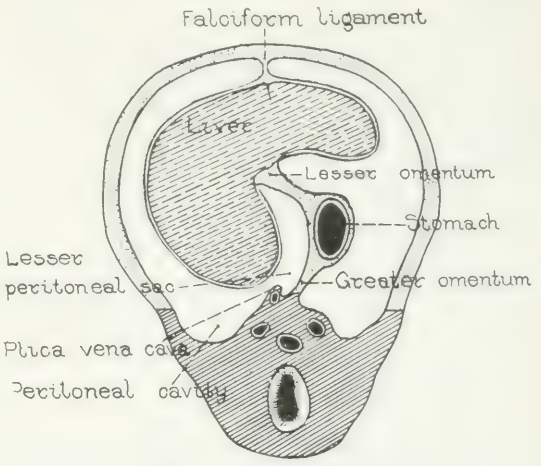

Fig. 3. Diagrammatic drawing showing the formation of the lesser peritoneal sac in an embryo of about 10 millimeters.

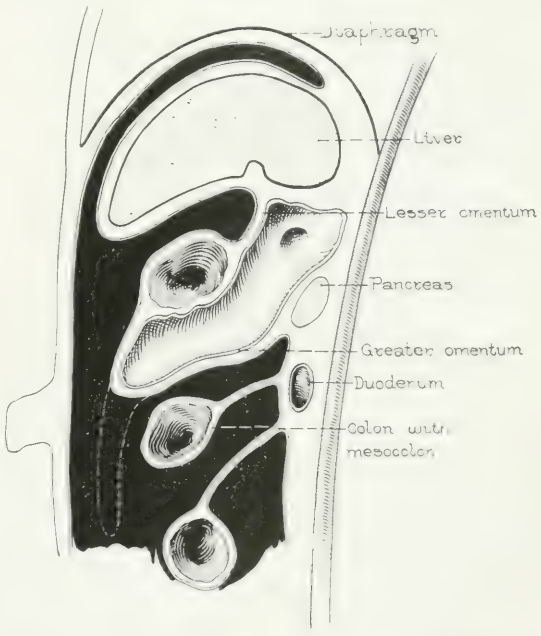

Fig. 4. Formation of the great omentum. (After Kollmann.)

Summary of Table I	Cases	Per cent
Cases examined	150	
Cases of general type seen in Figure 9	16	
Cases of type seen in Figure 10	2	
Cases with ligaments as described	18	12
Cases in which foramen of Winslow was closed	3	16.6 of 18
Cases showing other congenital defects	6	33.3 of 18
Average age, years	37.6	
Males	11	61.1
Females	7	38.8

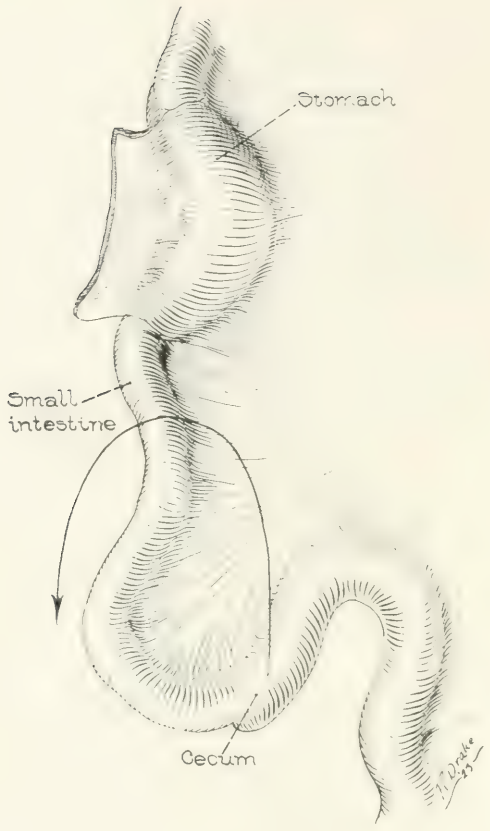

Fig. 5. First stage of intestinal rotation.

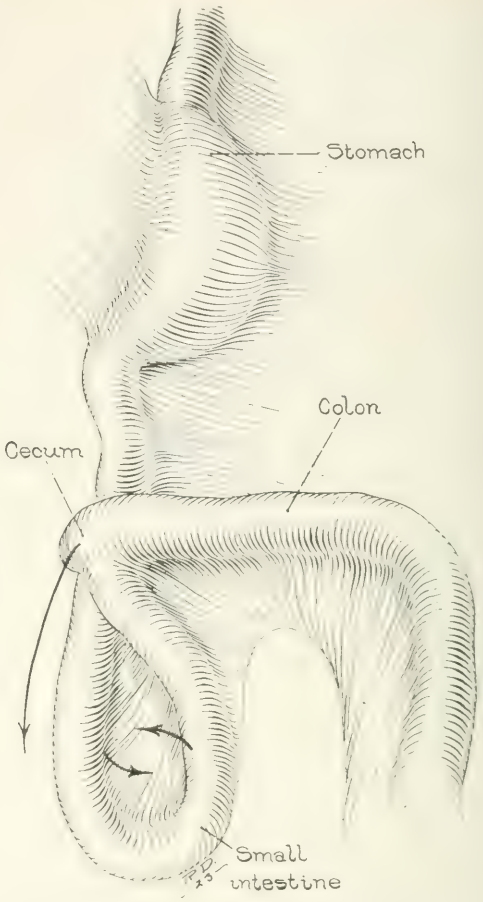

Fig. 6. Second stage of intestinal rotation.

the stomach with the anterior layer of the great omentum and thus in direct contact with the transverse colon. The foramen of Winslow is bounded ventrally by the free edge of the lesser omentum, dorsally by the inferior vena cava, cranially by the liver, and caudally by the duodenum. An extension of the lesser omentum, a variable distance to the right, explains the accessory folds as we find them. The point at which the free margin of the ventral mesentery (Fig. 2) crosses the intestinal tract, and its persistence caudad to the common bile duct determines the extent of the fold. That this point may vary seems obvious.

Virchow, in 1853, discussing chronic adhesions, mentions specifically the frequent attachment of the right colic flexure to the under surface of the liver and gall bladder and speaks of anomalous bands from the latter viscus to the pylorus and duodenum, evidently referring them, however, to a chronic, localized peritonitis. Morris was the first in this country to draw attention to these folds, describing them picturesquely as "cobwebs in the attic of the abdomen"; and he also attributed them to inflammatory processes.

Harris, Hamann, Homans, and others, report cases in which the symptoms led to a diagnosis of chronic cholecystitis, cholelithiasis, or duodenal ulcer, but which at operation showed only abnormal folds, undoubtedly of embryological origin, extending from the gall bladder to the duodenum or transverse colon, simple sectioning of which afforded permanent cure in the majority of instances. Homans found that combining sectioning of the ligament with a Finney pyloroplasty gave the best results. The majority of patients are

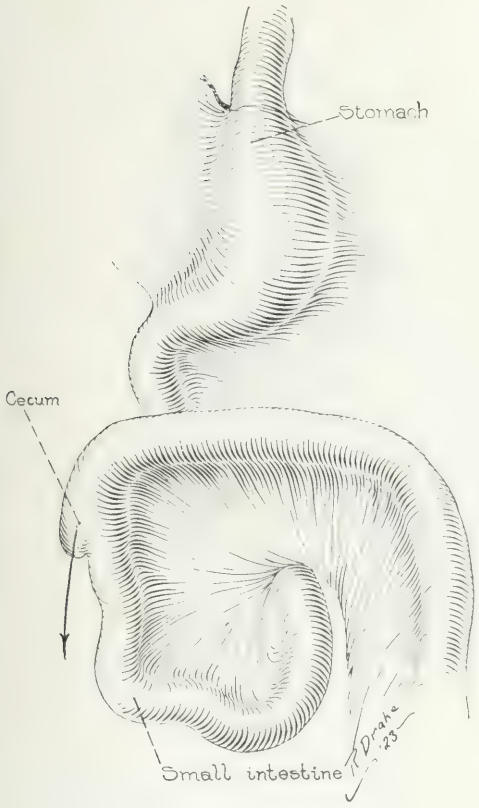

Fig. 7. Third stage of intestinal rotation.

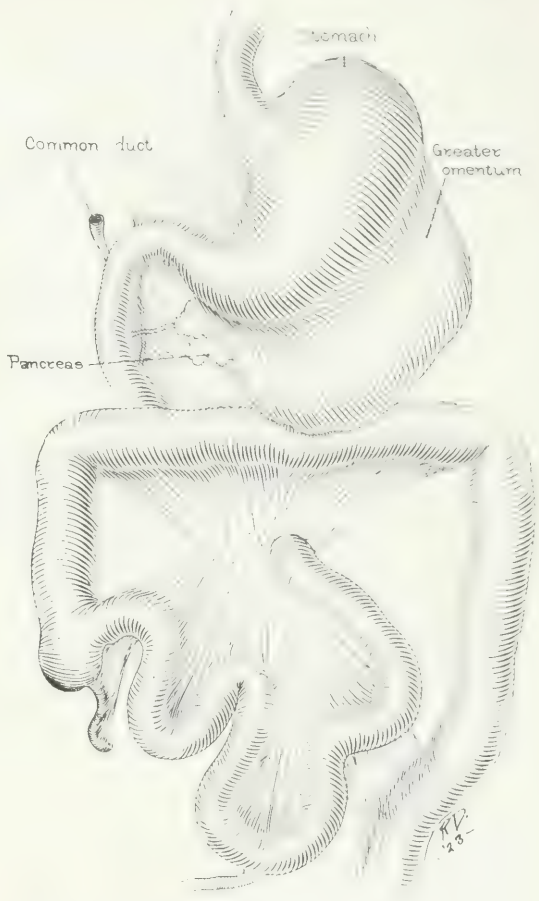

Fig. 8. Intestinal rotation completed. (After Kollmann.)

middle aged, and almost all the complaints are long standing and consist of indefinite symptoms such as sour stomach, fulness, and gaseous eructations, epigastric discomfort with dull, constant pain and occasional knife-like exacerbations. Sometimes slight relief is afforded by a moderate meal. Cole describes the roentgenographic findings in similar cases and emphasizes their importance in that they may simulate gall-bladder disease. Roentgenograms may show a partially constricted or compressed cap, the left superior surface of which has a thin, feathered-out appearance while the right side is clear cut. The deformity is most marked when the patient is in the erect or prone position and often is absent when he lies on the right side. Hubeny describes similar cases which have an elongated or dilated caput, fairly well defined with moderate fixation at the juncture of the first and second portions of the duodenum.

Moynihan describes a more unusual form of ligament found in some patients with vague dyspepsia, who, at operation show a membranous band, differing from Jackson's veil, broad above where it takes origin from the posterior abdominal wall, the under surface of the liver, the pelvis of the gall bladder, the cystic duct and duodenum, and narrowing below as it crosses the ascending colon to be lost on the parietal peritoneum. Below this band the cæcum and ascending colon are distended and soggy, the appendix often appears thick and stiff; the cæcum, ascending colon and terminal ileum in such cases require resection.

Harvey treats the entire subject of peritoneal folds and ligaments at length and re-

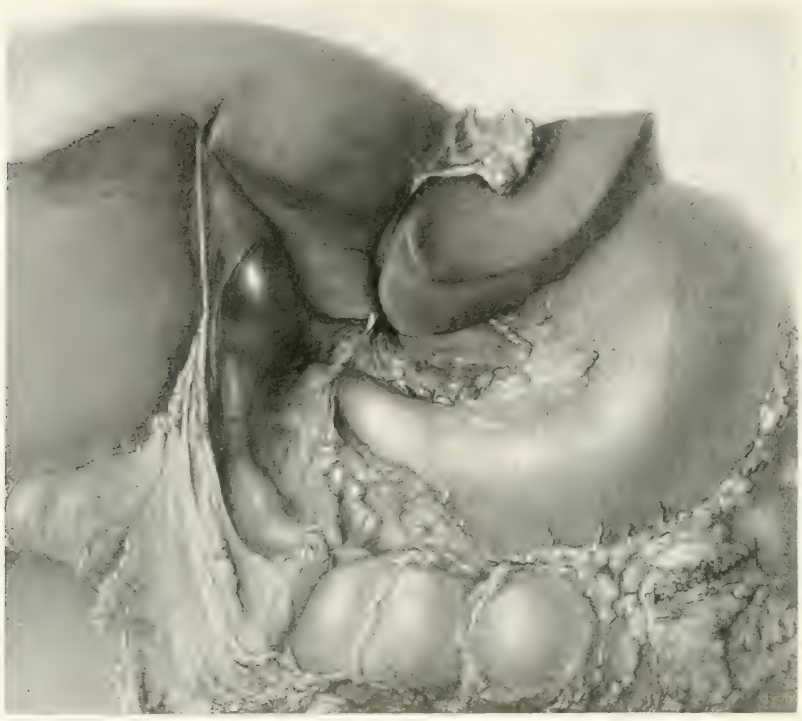

Fig. 9. (Case A354664.) Well-marked cystico-duodeno-colic ligament.

views the literature. He publishes a table showing the percentage of cases in which a cystocolic ligament has been found by various workers.

TABLE II—CASES REPORTED IN THE LITERATURE (HARVEY)

	Cases	Per cent
Jonnesco	100	25
Addison	40	30
Mollison and Cameron	50	20
Buy		25
Bricon	89	15
Reid	20	30
Leveuf	50	28
Sasslow	145	23
Harvey	105	18
Testut (Quoted by Kehr)	100	16

Ancel and Sencert (Kehr) found the ligament well developed in 48 per cent of cases and in some instances it completely closed the foramen of Winslow. The ligament has been found a number of times in fetuses and the newborn. Brewer reports 3 per cent of 100 cases in which a cystocolic fold extended over the fundus of the gall bladder. Harvey, in his series, recorded only those cases in which the ligament extended up the gall bladder more than one-third its length. Of the twenty subjects twelve were male and eight were female. Thirteen specimens were examined histologically and showed no evidence of infection.

A ligament was found extending from the gall bladder to the duodenum and colon in eighteen instances (12 per cent) of 150 consecutive necropsies at the Mayo Clinic. Only those cases are included in which the ligament extended at least half way up the fundus (Fig. 9, 16 cases) or where it existed as a continuous fold from the lesser omentum across the duodenum to the hepatic flexure of the colon (Fig. 10, 2 cases). In structure and appearance the ligaments were identical with the lesser omentum, all forming a direct continuation of it. They consist of veils of delicate, semi-transparent membrane containing variable amounts of fat, especially near their attachments. In the type shown in Figure 9 the ligament was usually attached with mathematical accuracy in a line parallel with the long axis of the viscus, over a base not more than 2 or 3 millimeters in width. The line of attachment was most often mid-

Fig. 10. (Case A119472.) Extension of the anterior fold of the lesser omentum across the duodenum to the right colic flexure.

way between the right and left margins of the organ, but occasionally it was to the right, and once it lay at its extreme right margin where it was reflected onto the surface of the liver. Infection was definitely ruled out as an etiological factor by both gross and microscopical examination of the ligaments and involved organs. In none of them was there the slightest suggestion of old or recent peritonitis. Two of my cases were in premature infants, of 8 months, in which there was no question of infection. In view of the fact that congenital deformities are often multiple, the presence of other developmental anomalies in six instances (33 per cent) is important.

The details of the cases are given in Table I. All the patients showed ligaments of the type illustrated in Figure 9 except Cases A400507 and A119472 which were of the type seen in Figure 10.

The ligament was present in 20 additional cases not included in the table because there were pathological processes present in neighboring organs which might have produced adhesions in the region concerned. Even in these, however, the ligaments were typical and, though somewhat thickened and shortened as a result of infectious processes, were undoubtedly congenital in origin. Inclusion of these would make 25.3 per cent of positive cases which compares more favorably with the findings of other writers previously listed.

Only two of the patients complained of gastric symptoms and in each these could be well explained on some other basis. The patient in Case A401367 had indefinite epigastric distress and dyspepsia for 15 years associated with marked constipation, all of which could readily be acccunted for by a chronically infected Meckel's diverticulum. The patient (Case A333504) had epigastric distress and belching after meals for 6 months prior to death, symptoms undoubtedly due to a tremendously enlarged spleen (myelogenous leukæmia). In none of the cases can the presence of the fold be said to have given rise to symptoms, and, taking into consideration the normal variations in position of the stomach, pylorus, and duodenum, it was evident in every case that these ligaments in

no way distorted the appearance of the gall bladder or gut, and with the organs in their normal positions there was no evidence of pulling or tension on the ligaments themselves. However, it is quite conceivable that they might produce symptoms. Figure 9 illustrates how an overfilled or sagging colon could drag on the gall bladder and cause symptoms simulating cholecystitis. The effect of traction on peritoneal surfaces in general is too well known to need further elucidation.

Aside from presenting an interesting variation in the normal anatomy of the gall-bladder region, the ligaments undoubtedly have a practical bearing in their relationship to neighboring pathological processes. With infection or disease in a nearby organ these ligaments thicken and shorten and then may be considered identical with true inflammatory adhesions so far as the production of symptoms and the surgical cure of them is concerned. They are not only potential adhesions themselves but furnish a guide for the formation of true adhesions, much as a trellis or piece of string guides the growth of a vine, and their presence explains why such dense adhesions between gall bladder and gut are found in some apparently mild cases of cholecystitis or duodenal ulcer, as judged by the primary pathological process, while in other apparently more advanced lesions there are few or no adhesions. Finally, it is essential for the surgeon to understand the nature and character of these ligaments in order that they be not mistaken for true adhesions and thus lead to false conclusions and needless or harmful surgery.

CONCLUSIONS

1. A cystico-duodeno-colic ligament is present in a small percentage of persons.

2. The ligament is a part of the lesser omentum and therefore of congenital origin.

3. Under normal conditions the ligament probably produces no symptoms and therefore requires no treatment.

4. The ligament is, however, a source of danger in that it represents a potential adhesion ready to thicken and shorten in response to neighboring pathological processes, and to furnish a guide and stimulus to the formation of true adhesions.

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TORSION OF THE SPERMATIC CORD WITH GANGRENE OF THE TESTICLE; REPORT OF TWO CASES

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The Crowell Clinic of Urology and Dermatology

A REVIEW of the literature shows the subject of torsion of the spermatic cord to be both interesting and instructive because the etiology is unknown and the diagnosis is most difficult and frequently not made until operation.

In an article in Surgery, Gynecology and Obstetrics, December, 1919, Dr. Vincent O'Connor finds but 124 cases of torsion of the spermatic cord reported in all the literature, but it would seem from a close study of this condition that it is quite frequent. However, it is generally undiagnosed before operation.

Authors who have studied this condition and reported cases recognize two distinct varieties: the acute type and the recurrent type. Both varieties are often incorrectly diagnosed as epididymitis, orchitis, or strangulated inguinal hernia. A definite diagnosis of strangulated hernia was made in over 50 per cent of the cases where vomiting was present.

ETIOLOGY

Torsion may occur at any age but in the majority of cases it occurs at the age of puberty. Seventy cases have been reported on the right side as against 54 on the left. The various authors agree that torsion is dependent upon two factors:

1. The abnormal attachment of the testicle to the spermatic cord or an abnormally spacious sac formed by the tunica vaginalis in which the testicle is suspended, causing what is called a movable or floating testis;

2. A sudden or violent contraction of the cremaster muscle.

Torsion may occur during rest or following some violent strain. Of the two cases I have seen, one came after jumping on a horse, the other while in the sitting posture.

PATHOLOGY

The twist is usually in the free portion of the cord contained within the tunica vaginalis and usually occurs from without inward. On opening the tunica vaginalis we find a blood-stained fluid or the cavity may be filled with blood clots. The operator is reminded of inspecting the abdominal cavity where he is confronted with either a twisted ovarian pedicle or a ruptured tubal pregnancy. The testicle is reddish blue or black, depending upon the duration.

SYMPTOMS

The subjective symptoms are not unlike those of any inflammatory condition of the scrotal contents and will not, as a rule, lead to a diagnosis *per se*. Pain is a constant symptom, varying in degree and is usually high up in the groin along the course of the spermatic cord.

Nausea and vomiting may or may not be present and can be dismissed as a possible aid to a diagnosis.

Swelling of the scrotal contents with marked œdema extending to the opposite side of the scrotal partition is fairly constant. The shortening of the cord by the twist gives the scrotal contents the appearance of being *pulled up into the groin*. Tenderness is a most important symptom but not as acute as in the infectious processes occurring in this region.

A diagnosis is exceedingly difficult and is very often not made until an operation is performed. The condition is frequently confused with strangulated inguinal hernia or incarcerated omental hernia, and they are excluded with great difficulty. In a differential diagnosis in this region, we usually have to exclude an acute epididymitis because of the frequency of this condition.

The most valuable points of differentiation:

1. Elevation of the scrotal contents as if it were pulled up into the inguinal region;

2. Marked œdema extending across the septum, giving the appearance of encroaching upon the other testicle;

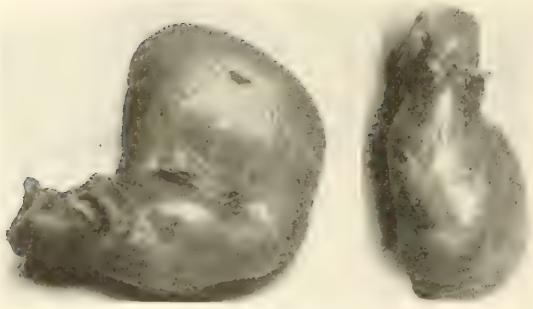

Fig. 1. Lateral view, showing twist in free portion of cord and constriction of circulation.

Fig. 2. Anteroposterior view of cord showing a more definite constriction below twist.

3. *Mild* degree of tenderness as compared with acute infectious processes of the scrotum.

TREATMENT

A few cases are on record where detorsion has been successfully performed when seen within a few hours after onset.

If the testicle can be saved and the circulation is not permanently interfered with, orchidopexy can be done. Eversion of the tunica vaginalis is usually sufficient.

In any case where gangrene, necrosis, or any permanent circulatory obstruction is met, removal of the testicle and as much of the cord as is indicated should be done.

CASE 1. J. M., age 19; a cavalryman by occupation; presented himself at the venereal wards of an army hospital giving the following history: The afternoon before, while on duty, he suddenly jumped from the ground astride his mount. A few hours afterward he felt a pain in the right side of the scrotum which was followed by slight swelling. On admission there was general malaise, no nausea or vomiting; temperature, pulse, and respiration normal. The patient did not look sick. He strenuously denied having had gonorrhœa, syphilis, or chancroid.

The physical examination showed a well nourished and developed boy, normal in every respect except for his local condition in the region of right groin and testicle. At the external urinary meatus there was a sticky, glairy mucous discharge from which smears were made. No cultures were made. The urine was clear except for a few shreds in the first glass. The prostate and vesicles were normal.

Patient was put to bed, an ice cap applied locally, given a liquid diet, and carefully watched.

Laboratory findings: The urethral discharge was reported *positive* for gonococci. Urinalysis was negative.

Preoperative diagnosis: gonorrhœal epididymitis.

Operation. The scrotal sac was opened in the usual manner. The cord showed a twist of one-half turn with complete obstruction to the circulation and gangrene of the testicle. Orchidectomy was performed. There was a complete and uneventful recovery.

CASE 2. G. H. T., age 34; S. clerk in clothing store. (Reported by courtesy of Dr. Brodie C. Nalle.) The father died at the age of 50 of typhoid fever. The mother died at the age of 61 of pneumonia. Four brothers are living and well. Two sisters are living and well. One brother and one sister died during infancy. There was no history of tuberculosis, malignancy, epilepsy, or insanity in family.

The patient's general health has been excellent. He has never had an illness of sufficient gravity to confine him to bed and has never been in a hospital before. He gives no history of accident, injury, or surgical operation. Patient had gonorrhœa 8 years ago. He was successfully treated and has had no trouble in this connection since. He gives no history of abrasion or sore on penis.

On the night of April 29, 1921, patient was seated on a couch when he was seized with a sudden sharp pain in the left testicle which was rather severe. During the night the pain moved up the left side of the abdomen. He thought the trouble was due to constipation so he took a cathartic with good results but was not relieved of the pain. The pain continually became more severe, and during the afternoon following the onset he noticed some swelling of the left testicle with slight tenderness. There was slight nausea but no vomiting Saturday afternoon (i.e. day following the onset). There was no history of chills or temperature. The day following the onset the patient consulted a physician, who thought his trouble was due to an epididymitis and gave him an ichthyol ointment, which did not give relief. This doctor continued to see him at intervals during the week following the onset of the trouble but the swelling and pain with tenderness seemed to become gradually worse. He had no trouble with constipation during this period. A week from the onset, the patient found temporary relief from cold applications. The swelling and hardness of the left testicle continued and on Saturday night—8 days from beginning of the trouble—Dr. Nalle saw him and advised him to enter St. Peter's Hospital. I saw him the following day (10 days after onset) in consultation with Dr. Nalle.

Physical examination. Showed a well-developed and well-nourished man, apparently normal in every respect except his local condition in the left groin and left scrotal region. There was no spasm, rigidity or tenderness over any portion of the abdomen except in this region and there was no visible peristalsis noted. Urethral discharge was absent. The prostate and vesicles were normal on rectal examination. In the left inguinal region and extending into the scrotum there was a hard mass connected with the testicle which was pulled high

up in the scrotum. The mass could be traced into the inguinal canal but the outline of the testicle and epididymis was obscured.

A tentative diagnosis of torsion of the spermatic cord with gangrene of testicle was made.

Operation. At operation the cord was twisted by rotation upon itself in a clockwise direction. The extent of the rotation was one-half turn. The testicle and that portion of the cord below the twist were gangrenous. Orchidectomy was done with complete and uneventful recovery—the patient leaving the hospital within a week.

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DYNAMIC ILEUS AND ITS CAUSATIVE FACTORS[1]

BY FRANK D. MOORE, M.D., F.A.C.S., CHICAGO

IN considering the question of dynamic ileus, we have to deal with a condition which is, perhaps, comparatively uncommon, and yet which is so little understood as to its definite causation and its means of prevention, as to prove a very serious question, when it does arise.

In reviewing the literature and in going over the work which has been done on this subject, there are two points which are immediately brought to one's notice: First, the variation in the meaning which different writers appear to ascribe to the term dynamic ileus. Some use it to mean only a spastic, non-mechanical obstruction of the bowel. Others use it to include all non-mechanical obstructions. The latter is evidently the most commonly accepted meaning of the term and it is with this meaning in mind that this discussion has been prepared, that is, any form of intestinal obstruction which is due, not to an actual blocking of the lumen of the bowel by adhesions, pressure from without, or tumors or foreign bodies within, but those forms which are due to an abnormality, either an excess or a deficiency in the contractile power of the intestinal wall.

The term paralytic, as a subdivision of dynamic, ileus is also a bit misleading, as many authors speak of all non-mechanical ileus as paralytic, the dynamic as a form of spastic paralysis and the adynamic as a flaccid paralysis. It is undoubtedly true that many more cases of ileus, particularly the postoperative ones, are paralytic than was formerly supposed. It has even been estimated that as high as 65 to 70 per cent of all cases of intestinal obstruction are, in reality, forms of paralytic ileus.

The second point which we note is the scarcity of any real research work on the direct causation of dynamic ileus. Considerable work has been done on the direct cause of death in cases of intestinal obstruction, and numbers of cases have been cited, reporting the coincidence of various affections with the sequelæ of symptoms, known as intestinal obstruction, while others report the pathology found at autopsy. It seems fairly well established, at present, that the direct cause of death in these cases is the absorption of toxins produced in the obstructed loop of bowel and formed as the end-products of disintegrated proteins. A considerable amount of experimental work done upon animals seems to substantiate this theory very materially.

It is also a recognized fact that certain operative conditions; namely, prolonged ex-

[1]Read before the Chicago Surgical Society, March 2, 1923.

posure of the intestine, eventration of the bowel, excessive manipulation at time of operation, as well as injury done to the bowel-wall through rough handling, all tend to produce an atonic condition of its musculature. Other accidents due to the operative interference may be thrombosis or embolism of the mesentery with resulting anæmia of the blood vessels supplying the part. In fact, the predisposing causes that have been considered as responsible for dynamic intestinal obstruction are numerous, almost too numerous to mention. Among them are:

Atony from excessive manipulation; atony from injury at time of operation; atony from a previously weakened condition or from a general systemic depression; mesenteric thrombosis or embolism; local peritonitis; general peritonitis; pre-operative saline purging; postoperative purging; pre-operative and postoperative starvation; excessive draining of the tissues through vomiting or prolonged withholding of fluids; eventration of the bowel, either through accident or through faulty technique at operation; overdistention by gas; bacterial infection; anæmia of the mesentery from any cause; severe and chronic constipation; reflex atony from disturbances of the nervous system in other parts of the body; postoperative uræmia; toxicity producing spasm of the bowel; increased susceptibility of the nervous system previous to operation; disturbance in nerve-control; overactive sympathetic; inactive vagi.

A previous weakened condition from long or exhausting illness and the pre-operative use of saline purges are predisposing causes, as well as postoperative overdistention by gas, local or general peritonitis, or post-operative uræmia.

Toxicity in any part of the bowel may cause a spastic condition, although this is found much more frequently in primary spastic ileus than in postoperative obstruction.

Excessive manipulation with consequent prolonged exposure of the bowel wall and probable trauma to delicate tissues, occurs in a number of reported cases as a probable causative factor. This can, of course, be eliminated by a good technique in a number of operations, but is also unavoidable in others, such as enucleation of large tumor-masses, cases complicated by necessity of resection of portions of bowel, etc.

A previous weakened systemic condition is noted also in a large number of cases, and produces a flaccid paralytic condition usually of a large portion of the bowel. In these cases, there is a decided predisposition to a weakened musculature, not only of the bowel wall, but of the whole system as well. A general systemic depression resulting either from the exhausting effects of the operation, loss of blood in shock, or to long-continued previous illness. Many surgeons lay stress on the fact that they have found in their cases of paralytic ileus, an area of infection, either a localized or a general peritonitis, in which case the paralysis of the intestine occurs as a protective effort on the part of nature to prevent the spread of infection.

Pre-operative saline purging exhausts the musculature of the bowel by overexertion before operation, leaving it in a condition very subject to later overdistention by the formation of gas, and without sufficient contractile force to overcome the resistance.

As contrasted with the various forms of flaccid paralytic ileus, we have reports of a number of cases apparently due to an increased susceptibility of the nervous system previous to operation and resulting in a spastic rather than a flaccid form of paralysis. These cases were, for the most part, in women, and in persons of very nervous temperament, who had been very much frightened at thought of operation, or worried over its possible outcome. The spasticity in these cases may be in the form of a ring only, or it may involve a considerable length of the bowel.

The toxic forms of ileus are spastic in type and are due to the absorption of toxins, either such mineral poisons as lead, vegetable poisons such as the various ptomaines, or the products of bacterial degeneration. These are rarely found as secondary or postoperative types of obstruction.

Reflex types of ileus may be due to disturbances in various portions of the body and in these cases can be attributed only to a

reflex disturbance of nerve-control. While operations on the pelvis, on the appendix, or on the kidney are particularly prone to this complication, still it has been known to follow orchitis, hydrocele, compound fracture of the bones of the leg, pregnancies, vaginal hysterectomies and operations on the breast. Atony of the bowel wall may occur from lesions elsewhere in the abdominal cavity, as well as from diaphragmatic pleurisy, etc.,—the action in this case being reflex. A general systemic depression may also produce a general atonic ileus.

While all of these conditions are mentioned and numbers of cases are cited to confirm the opinion that they are direct causes of acute dynamic ileus, the question of the actual mechanism is still in doubt. What is back of these predisposing causes? Why should any of them result sometimes in an attack of acute intestinal obstruction and sometimes not? Why should so many conditions, themselves so widely different, result in this particular bit of pathology? These questions have not been clearly answered. However, in so far as it has been worked out, the most probable etiology is that of disturbances in innervation either from the sympathetic or the central nervous system or both. This is the most widely accepted theory and most of the others really depend upon it as a fundamental working basis.

The intestinal wall derives its innervation from the vagus and the splanchnic nerves, the latter communicating with the vagus and themselves arising from the anterior cornual cells of the cord, together with their corresponding ganglia and sympathetic plexuses in the wall of the intestine itself. The vagus nerve innervates the whole of the small intestine and the effect of irritation of its fibers is to increase peristalsis. On the other hand, irritation of the filaments of the splanchnic nerve tends to inhibit movements of that portion of the intestine controlled thereby and also causes an anæmic condition of its blood vessels, while division of the splanchnic causes hyperæmia.

A paralysis of the gastro-intestinal tract, then, may result from an abnormal overactivity of the sympathetic system or from an abnormal inactivity of the vagi. This theory appears all the more probable in view of the fact that a reflex irritation of the sympathetic may be set up by such operations as that for hydrocele, with no direct stimulation of the intestinal nerves at all, the reaction being necessarily reflex.

The direct cause of death has been much studied and considerable experimental work has been done on animals with the result that death has been definitely determined to be due to the absorption into the system through the blood stream of the toxic end-products of disintegrated proteins split up within the obstructed and pathological loop of bowel. This toxicity, together with the general dehydration of the body-tissues and the depression of the nervous system, is the direct cause of death.

The various methods of treatment are all founded on the basis of combating toxicity and dehydration by transfusions and injections as first treated and, secondly, of opening and draining the obstructed loop and also of removing the toxic products to prevent their later absorption into the blood stream through another, perhaps healthy, portion of bowel.

SUMMARY

There is considerable confusion in the terminology of acute ileus, aside from the strictly mechanical forms of obstruction. The best acceptance, however, is that of dynamic ileus as including all those forms of acute intestinal obstruction which are non-mechanical and which are due to some abnormality, either excessive or deficient, in the contractile power of the intestinal musculature. This abnormality may result in either the spastic or the flaccid type of paralysis.

There are many causes given to account for the occurrence of acute dynamic ileus, including the widest possible range of pathological conditions. All of these, however, are in themselves only predisposing causes, and all must, of necessity, have back of them, some really fundamental factor as the basic etiology.

The most widely accepted and, at present, the most correct theory advanced as to the nature of this fundamental factor, is a disturbance in the innervation of the bowel

wall, whether this disturbance takes place in the plexuses in the intestinal wall, those of Meissner and Auerbach, in its sympathetic ganglia, or in the cord itself, is not essential, and undoubtedly varies with the particular causative factor in each case.

The direct cause of death is generally conceded, in dynamic ileus, as well as in mechanical obstruction, to be absorption into the body of the toxic products of disintegrated proteins formed within the obstructed loop of bowel, together with dehydration of the body tissues.

The treatment consists, first, in combating the toxicity and dehydration, and, secondly, in relieving the obstruction by drainage of the obstructed bowel and removal of its toxic contents.

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OVARIAN HÆMATOMATA

By E. MURRAY BLAIR, M.D., C.M., Vancouver, British Columbia

IT is rather an extraordinary thing that hæmorrhages of the ovary have, until recent years, received such little attention from the profession, despite the fact that the ovary, of all the organs of the body, is the most prone to hæmorrhage. It may have been generally felt that the pelvic organs in woman have a God-given right to hæmorrhage for reasons best known to themselves and the less comment the better.

The great majority of ovarian hæmatomata were considered as possibly without demonstrable pathology. In consideration of the close proximity and closer relationship with the physiologically bleeding uterus, was it not a fair assumption that most ovarian hæmorrhages were physiological?

The important elements of the ovary according to present-day teachers are:—(1) follicles, (2) corpus luteum, and (3) stroma.

Believing that there was an etiological reason for the origin of hæmatoma of the ovary, Novak (1) endeavored to explain the phenomena from a scientific basis. He showed, I think, pretty conclusively, to the great rank and file of the profession, that all hæmatomata of the ovary originate from one of the above basic factors.

It has recently been shown by Sampson (2) very conclusively that certain hæmatomata occur in the ovary which do not find origin in any of these basic ovarian factors, and for the etiology of the tumors one must look outside the ovary altogether. His masterly articles of recent dates have, as it were, brought many knotty points in the pathology of the female pelvis into a clear light. He has shown that certain ovarian hæmatomata have an endometrial origin. He believes that particles of endometrium become implanted on the surface of the ovary, that the ovary stimulates the endometrium there implanted as it does in the uterus, that a cyst is there formed and continues to grow as the embedded endometrial tissue continues to "menstruate." He seems satisfied that it is a simple regurgitation of menstrual blood accompanied by endometrial tissue along the fallopian tubes. His theory has, indeed, many convincing arguments.

For the past 25 years it has been an established histological fact that uterine epithelial tissue may be encountered in other pelvic organs than the uterus, as the tube, ovary, broad ligament, rectovaginal septum, etc. How this uterine epithelium, often true endometrium, can be found outside the uterus has been under discussion for many years. The earliest theory that I can find is quoted by Frank (3) and is that by von Recklinghausen, 1896, sustained later by Peck, again later by Ernst. They speak of adenomyoma of the genital tract generally and offer proof that the etiology is developmental from mesonephric rests. The majority of their cases were later refuted pathologically by Robert Meyer (4) and others. Cullen's (5) articles on adenomyoma of the rectovaginal septum are of much interest. He shows repeatedly the presence of uterine epithelium and even mature endometrium in the rectovaginal septum. Concerning the etiology he states: "We know nothing as to the origin of these tumors but it is certain that their glandular elements are identical with those of the mucosa of the body of the uterus."

Russel (6) reported the first case of menstruating endometrium in the ovary, and he bases his theory of origin on the statement that the embryological uterine epithelium and the ovarian germinal epithelium arise from a common source, and it is reasonable to suppose that occasionally an exchange of function could take place.

Meigs (7), in a recent study of material at the Free Hospital for Women, Brookline, corroborates the microscopic findings of Sampson. He suggests that "certain parts of the germinal epithelium of the ovary are able to undergo a metaplasia and take on the function and histology of endometrium. He

gives the histological findings which suggest this hypothesis.

The theory of Janney (8) is to my mind the most rational explanation of the phenomenon. Our own explanation of the etiology as here given, is chiefly along the same lines as his theory. Whether uterine epithelial tissue is implanted in the ovary developmentally or in mature life is still a debatable question, we agree.

THEORY OF ETIOLOGY

It is, I think, an established histological fact that the endometrium is derived through a long developmental process from the primitive funnel of the muellerian duct. The ovary is derived from an area known as the tubal area and develops chiefly from the median side of this area. Usually the mullerian duct lies laterally to this area, but by lying medially, at once the developing uterine epithelium would be in close proximity to the developing ovary, and we can readily conceive of a portion of this uterine epithelium, the endometrium to be, becoming included in the ovarian development. Why, then, do we not get cystic formation in the ovary immediately menstruation starts? Naturally the same circulating ovarian hormone will induce menstruation in endometrium wherever it may be.

1. It may be that primitive uterine epithelium in the ovary is retarded materially in its development on account of its unusual surroundings.

2. If the implantation be at or very near the surface of the ovary, hæmorrhagic cyst formation may gradually progress, but so slowly does it progress because of its foreign environment, that it usually appears as a clinical entity during the latter years of menstruation.

3. Should the implantation be deep in the substance of the ovary, the back pressure of blood menstruated, together with the general hindrance caused by the surrounding ovarian tissue, usually causes early atrophy of the endometrial tissue *unless acted upon by an outside stimulus.*

4. The same stimuli which cause follicular corpus luteum and stromal cysts to increase to pathological entities probably act on the mature endometrial implants, carrying them through to cyst formation and perforation.

STIMULATING FACTORS CAUSING HÆMORRHAGE

Believing as we do that some stimulating factor must enter in, in the great majority of cases of pathological cyst formation, whether of endometrial origin or not, we next turn to the causal factors. The causes are legion, chiefly predisposing, and are best summarized by Stein (9) as follows:

Local. (1) Menstrual (excessive menstrual hyperæmia); (2) non-menstrual (a) active hyperæmia (acute or chronic oophoritis); (b) passive hyperæmia (thrombosis, torsion, varix); (c) primary or secondary neoplasms.

General. (1) Diseases altering the composition of the blood: (a) Infections—as typhoid, acute exanthemata, etc.; (b) general disorders of nutrition (anæmia, chlorosis); (c) hæmophilia; (2) phosphorus poisoning; (3) burns; (4) venous congestion of abdominal viscera, as in heart and lung diseases.

Considering the subject from its broadest aspect, we believe that the great number of ovarian hæmatomata may cause little or no disturbance clinically and the tumors are found accidentally at operation or autopsy. Others again may cause serious menstrual and abdominal symptoms and even abdominal hæmorrhage through perforation with possible endometrial implantation on any peritoneal surface.

These facts have recently been brought home to us in a very striking manner, and the belief that possibly our experience will be of very material benefit to others has prompted us to report the following cases:

CASE 1. Patient, a female, age 31, a nurse, unmarried and very probably a virgin. She consulted Dr. Riggs regarding severe, intermittent pains in her lower abdomen, concentrated in her lower right quadrant, with tenderness just over Poupart's ligament and pubes.

Her menses had always been regular from age 14, appeared every 31 days, and of 3 day interval, accompanied by a varied amount of pain always. In October, 1921, she had sharp pains in the pelvic region which came and went intermittently, occurred at the beginning of the menstrual flow and lasted from 1 to 5 hours. She felt nauseated but did not vomit. She says she felt pains chiefly in rectum and vagina.

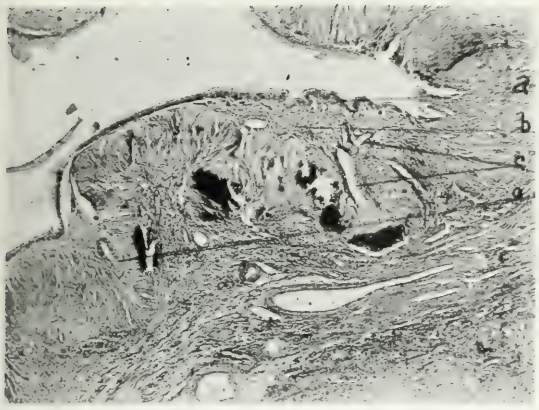

Fig. 1. Low power photomicrograph showing *a*, columnar epithelium; *b*, stromal tissue rich in blood vessels; *c*, numerous well-developed glands.

In November, 1921, she had more severe pains than usual across lower abdomen during her menstrual period.

In July, 1922, 2 days before menses, she had an acute attack of pain in her right lower quadrant and extending across pelvis was felt in rectum and vagina. Pain lasted some 6 hours.

In January, 1923, she had a sudden, sharp attack of pain in the lower abdomen, concentrating just above Poupart's ligament, right. She had two or three exacerbations of pain during the day. Moderate general rigidity. She had a feeling of being "full of gas." Acute pain lasted 1 day and she felt miserable for several days. Soreness in the abdomen persisted, and she could not straighten up properly. She was nauseated but did not vomit.

Examination 3 days after attack showed tenderness over right ovarian region and McBurney's point. Rigidity was chiefly on right side with rebound pain. By rectal examination no mass could be felt. Although not typical, a provisional diagnosis was made of acute exacerbation of chronic appendicitis with appendix located over brim of pelvis. She had a temperature of 101°; pulse, 84; blood pressure, 112–68; white blood cells, 13,600; polymorphonuclears, 74 per cent.

At operation performed by Dr. H. W. Riggs, at the Vancouver General Hospital, the abdominal viscera were found stained as though with old blood, a small blood clot was removed from the cul-de-sac, the appendix was atrophied, no signs of inflammation. In right adnexal region was found a spherical cystic tumor, some 7 centimeters in diameter, springing from the remains of the right ovary. Very little ovarian tissue remained. The cyst and ovary and tube were bound down by adhesions but were delivered quite easily. On pressure, a brown chocolate-colored substance spurted from the cyst through a small perforation, and right oophorectomy and appendectomy were performed. The right tube was apparently normal.

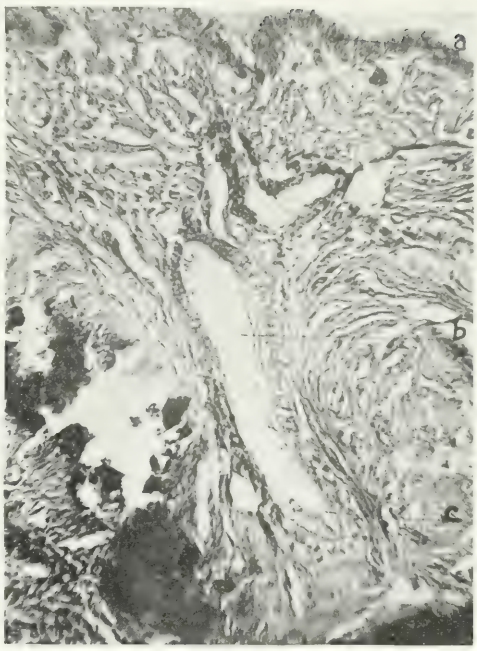

Fig. 2. High power photomicrograph showing part of Figure 1. *a*, Columnar epithelium; *b*, well-developed gland; *c*, cilia (well seen with oil immersion).

Macroscopic examination. Specimen consists of a simple thick-walled ovarian cyst, some 7 centimeters in diameter, through which is exuding a thick, syrupy, chocolate-colored fluid from a small perforation.

Microscopic examination. Figure 1 is a low power photomicrographic view of portion of cyst wall and cyst cavity. A regular and unbroken layer of columnar epithelium is seen lining the inner surface of the cyst. Below is a loose layer of stromal tissue rich in blood vessels. Numerous well developed, somewhat dilated glands are seen interspersed irregularly throughout.

Figure 2 is a high power view of part of the same field as above. Columnar epithelium is here well seen lining the cyst. The glandular development is quite matured. In the interior angle of the larger gland cilia are well seen with oil immersion magnification.

Figure 3 is a high power view of a near-by field; shows quantities of old and new blood in interstices of stroma.

Case 2. Mrs. A. S., age 37, married. Very unsatisfactory history could be obtained at time of operation. Is a very garrulous patient with remarkable multiplicity of complaints referred to nearly every region of her body. Her history is considered quite unreliable and so of no value.

At operation by Dr. J. J. Mason, on opening abdomen, bilateral cystic ovarian masses bound down by dense adhesions to all surrounding tissues

Fig. 3 (at left). (Case 1.) High power photomicrograph of loose stroma with marked deposit, old and new blood.

Fig. 4. (Case 2.) Low power photomicrograph of normal endometrium (functionating) implanted in ovarian tissue.

were found to fill the pelvis. Right ovary was practically disintegrated and densely adherent to broad ligament. On removal some ovarian tissue was undoubtedly left behind. The left ovarian mass was adherent in the cul-de-sac. Neither tube, though involved in masses, showed inflammation. Bilateral salpingectomy, bilateral oophorectomy (partial), suspension uteri and appendectomy were performed.

Macroscopic examination. Specimen consists of two tubo-ovarian masses, each a tube and part of an ovary matted together by adhesions. Originating from left ovary is a cystic mass, 7 cm. in diameter. On opening a thick, chocolate-colored syrup was liberated. Sections taken from wall of cyst and accompanying tube.

Microscopic examination. Figure 4 is a low power photomicrograph showing true endometrial tissue in every detail, and implanted on apparently normal ovarian tissue.

Figure 5 is another low power photomicrograph of the same area, still showing true endometrium.

Figure 6 is a high power field of a portion of Figure 5 to show the maturity of the gland development.

It would seem pretty well established that the two cases here described are hæmatomata of endometrial origin. Here are cystic tumors with the characteristic chocolate-filling contents, lined by columnar epithelium. One contains loose stroma, rich in blood vessels with mature gland formation in which cilia can be demonstrated with deposits of old and new blood. The other shows true endometrial tissue in a beautiful manner. We are proud that we have been able to demonstrate unquestionably the presence of gland formation in the menstruating area in both cases. Case 1 required the cutting and examining of some 30 slides before glands were found. It is, perhaps, possible to discuss a primitive or incomplete endometrial tissue under very abnormal surroundings, without the presence of glands. But endometrial tissue which menstruates is a functionating endometrium, and we find it hard to conceive of a functionating endometrium where glandular development cannot be demonstrated.

The writer has carefully examined every specimen of cystic ovary received at the Vancouver General Hospital in the last year, but has failed to find any hæmatomata that showed any possibility of endometrial origin. Two fine specimens of hæmatomata of undoubted corpus luteum origin were found. No specimens, however, were recut for the purpose of further search.

Should the regurgitating theory of Sampson be a fact, and well may it be a fact despite our belief to the contrary, one of the great lessons for the gynecologist is that practically always a retroversion precedes and aids the regurgitation process. We do not mean that every symptomless retroversion should be corrected, but in every operative procedure in

Fig. 5. Low power photomicrograph of same area as Figure 4 still showing true endometrium.

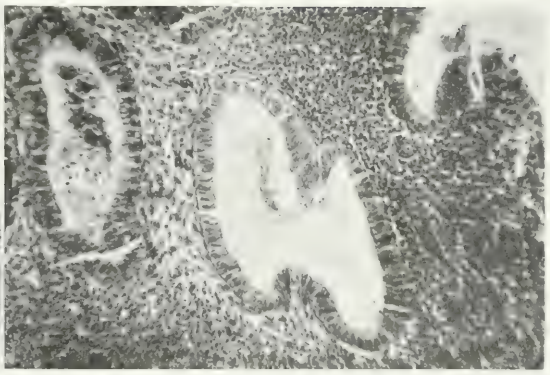

Fig. 6. High power photomicrograph from Figure 5. Note perfection of gland development.

the pelvis it should be considered. In an examination of the literature we note that the condition at times apparently followed some operative procedure. All too often do we find that after operation on tube, ovary, myoma or extra-uterine pregnancy, the uterus is left with less support than it had, a prey to the adhesions which must invariably follow to some degree. The old axiom of Murphy to "Get in quick and get out quicker" is not to be taken literally at the expense of uterine position.

CONCLUSIONS

1. Perforating and especially recurrently perforating hæmatomata of the ovary are probably all developmental uterine epithelium implantations.

2. The great majority of hæmatomata which do not perforate but may still cause menstrual symptoms and abdominal pain, are follicular, corpus luteum, or stromal in origin.

3. The same stimuli needed to carry follicular corpus luteum and stromal cysts of the ovary on to pathological entities, act, we believe, on implanted uterine epithelium to carry it on to mature endometrial tissue, cyst formation, and perforation.

4. Recurrent attacks of abdominal pain in the female pelvis, during the child-bearing period, may simulate appendicitis but be caused by a recurrently perforating hæmatoma of the ovary of endometrial origin.

5. Sampson's theory of origin of perforating ovarian hæmatomata, while still without substantiation as far as we know, is a plausible theory. In view of that fact the notice of the profession should be drawn to the added complication which may arise from a uterus in mal-position.

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DEPARTMENT OF TECHNIQUE

A FURTHER REPORT UPON THE EPITHELIZATION OF THE MAXILLARY SINUS IN CHRONICALLY DISEASED STATES[1]

By J. EASTMAN SHEEHAN, M.D., F.A.C.S., New York

THE operative experience of the 15 months which have elapsed since I had the honor of presenting my first report to the society will, I trust, prove sufficiently interesting and perhaps valuable, in view of the importance of the subject, to justify this further presentation. In addition to the account which I shall give of that experience and the extent to which it has resulted in modification of the views expressed in the earlier paper on the treatment of disease of the maxillary cavity, I shall also attempt a general epitome of antral disease.

The experience which has resulted in such conclusions as are herein set forth is not, of course, the detached or separate experience of the last 15 months, but rather of 4 years of work performed in this country and abroad of which the shorter period involves the more recent and, therefore, the more valuable part, since in it have been more thoroughly tested and determined the correctness of such of the earlier methods as have been retained in their integrity and the desirability of such of the modifications of those earlier methods as have since been adopted.

While I am entirely sensible that, in so far as what I am to relate is the result of purely personal experience, it is questionable whether it would justify the demand on your time and patience, yet since that experience has been largely gained through the generous assistance of the acknowledged authorities both here and abroad, to whom I can do no more than humbly express my grateful appreciation, it can in a proper sense be said to be more than a mere personal experience that I am recording. Moreover I have had the benefit of the disinterested and unselfish assistance of devoted associates and the advantages resulting from the reference by my professional friends and associates of interesting operative opportunities.

Finally, in expressing my obligation to others, the demonstration of the work to which your attention will be directed is made much more satisfactory and intelligible through the exceptional drawings prepared by the artist, Mr. A. Feinberg.

Fifteen months ago there was no literature to consult on this subject and, in consequence, each man who dealt with it could theorize from his own limited experience only. There was one exception to the absence of bibliography. Stratt, of Berlin, had set forth his unsuccessful attempts in 1889 to transplant full thickness skin to this cavity. Hardly a helpful treatise. During the last 15 months, however, Ferris Smith, of Grand Rapids, Michigan, who is here tonight, in a very important article, which appeared in the *Journal of the Michigan State Medical Society*, April 22, 1922, reported thirty-two instances of epithelization of this cavity. My own experience has not been so great as his, numbering only 20 operations. There is a marked similarity, however, in the reported experience and conclusions of both of us working at different posts and in complete ignorance of each other's methods.

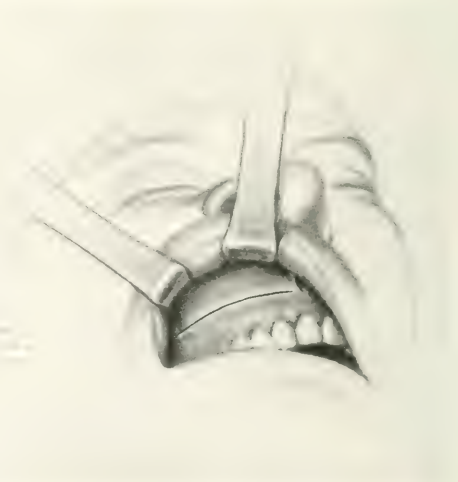

Fig. 1. The gum incision extending from the labial frenum to the premolar tooth. Note the incision is made well above the teeth. This allows for easy approximation of the flaps when stitching.

[1] Read before the New York Academy of Medicine, February 28, 1923.

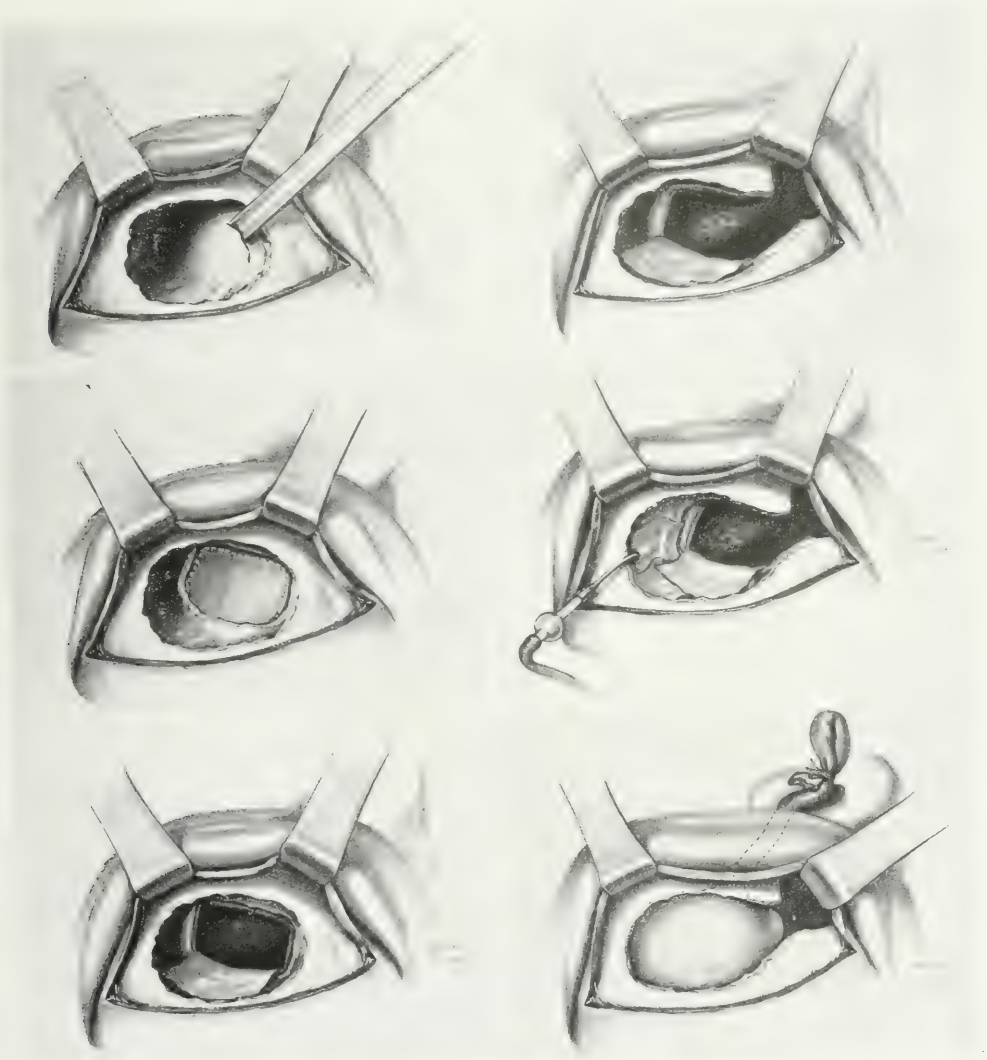

Fig. 2. The radical operation. The periosteum and mucous membrane are held out of one's way with suitable retractors. Anterior maxillary wall has been removed exposing the recess. Chisel tearing away the maxillary nasal bony wall.

Fig. 3. The anterior maxillary and nasal bony walls removed, leaving the nasal mucosa *in situ* intact. The dotted line represents the proposed incision in the nasal mucous membrane.

Fig. 4. The flap of nasal mucous membrane is turned into the antrum resting on its floor to provide a future lining. The inferior turbinate bone is trimmed throughout its entire length at a previous sitting, to destroy contact and not function.

Fig. 5. The ultraradical operation. Removal of the angle of bone formed by the junction of the anterior and nasal walls, thus making a common opening between the nose and the maxillary recess anteriorly. Many times disease exists in this angle which necessitates the removal of the entire bone in this area. Note the inturned nasal mucous membrane to the floor of the antrum to provide a lining. The inferior turbinate is freed from contact, still its function is conserved.

Fig. 6. Skin grafts in position and made adherent to the bony walls by using the Ballance suction tube.

Fig. 7. Even and firm pressure is exerted upon the grafts by inserting a rubber balloon through the nose and inflating it to the desired degree of tension; its catheter attachment is tied with silk thread.

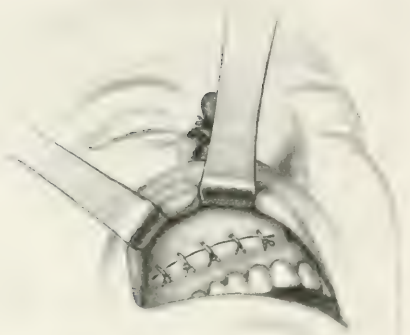

Fig. 8. The incision is closed with horse hair and sealed with tincture of benzoin.

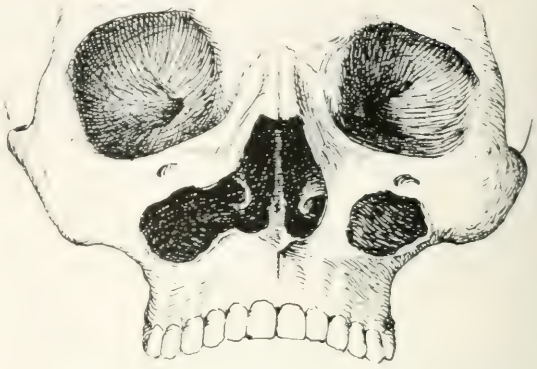

Fig. 9. The finished operations on skull. The ultra-radical operation on right, the radical operation on left.

Since writing this article my attention has only recently been drawn to a paper entitled, "Plastic Surgery, Its Interest to the Oto-Laryngologist," written and delivered by Ferris Smith before the Throat Section of the American Medical Association which convened at New Orleans, in April, 1920, in which he states that he has epithelized the maxillary sinus fourteen times. Surely priority in this work is his.

The predisposing factors, causes of infection and symptomatology, are too well known to require more than the briefest reference. Unfavorable anatomical configurations, such as abnormalities of the middle turbinate, deflections of the nasal septum, disease of the nasal vicious cycle; in short any condition which may cause partial or complete blockage of the airway constitutes a predisposing factor. Infection may be communicated to the sinus by the extension of disease from the nasal mucous membrane through the circulation or through the alveolus as in the case of the eruption of teeth or the extension of dentigerous cysts into the cavity. It may also be the consequence of traumatic causes and of such chronic diseases as tuberculosis, syphilis, malignancy, and leprosy.

Local symptoms do not always indicate the infection, and its existence is not infrequently disclosed by asthma, bronchitis, bronchiectasis, rheumatism, indigestion, either gastric or intestinal, and pain of a dull character in the lumbar region with extreme lethargy, simulating diabetes. The last condition was the only symptom in 1 of the 20 cases constituting my own experience. Local symptoms, as might be expected, may consist of a one-sided discharge either of a serous, mucoid, or purulent character with or without odor, cacosmia, neuralgia, face ache, migraine, etc. Pain over the maxillary antrum is no necessary part of chronic suppuration in this channel, since it may be suggestive of periosteitis, gumma, or new-growth, and may merely manifest an acute exacerbation of a chronic condition.

PATHOLOGY

The mucous membrane becomes hyperæmic, then hyperplastic, with œdematous changes, grayish in color, wrinkled and papillomatous, loosely held by the underlying bone, later connective with retention cyst formations.

In places the glands and vessels may become atrophied, in others dilated. The ciliated epithelium in part or in whole is changed to the pavement form with round-cell infiltration; ulceration of the bone may take place, and generally means an infection of a virulent organism with increased intrasinal pressure. Necrosis and bone atrophy may also appear in the pathological picture. Local alveolar necrosis is generally dental in origin, as from an infected or abscessed tooth.

The diagnosis depends upon the history, signs, and symptoms, and is assisted by the transilluminator introduced by Hevyng. The dental findings and roentgenogram afford more or less confirmatory evidence. The exploratory needle of Schmidt should be used, and there should be lavage of the antrum. Many times the pus is fetid and frequently flocculent. At other times a small amount or even a decided turbidity is sufficient to determine the diagnosis of empyema.

If one uses a black vulcanite vessel to receive the returned fluid, any trace of pus will be observable. The antrum should be probed after the exploratory needle is retired to determine the presence of polyps and cysts, and sometimes necrosis of the bone may be thus ascertained.

PRE-RADICAL OPERATIVE TREATMENT

It is quite difficult to determine beforehand what prospects there are of curing a chronic case by lavage through the nasal wall with instillation of drugs.

My practice is, as advocated by Dahmer, to make a very large opening in the nasal wall with an inturn mucous membrane flap to prevent closing by granulations. The inferior turbinate bone is trimmed throughout its full length to destroy contact. Function is not affected. The sinus is irrigated every second day using a 5 per cent solution of magnesium sulphate. This solution has several advantages, it being a mild antiseptic, an analgesic, and a solvent of mucus. The irrigations are carried out every second day for 5 or 6 weeks with instillations of argyrol, silvol, collene, and, if there is a decided and progressive diminution in the amount and purulence of the discharge, the treatment is continued. After the first week, the sinus is ionized every fourth or fifth day, using zinc sulphate. The results obtained at times through this form of treatment are surprisingly gratifying.

If these methods fail to effect a cure in from 6 to 12 weeks the reason is generally excessive polypoid degeneration of the mucous membrane or possibly bone involvement. Radical surgery is then advised.

THE OPERATION

Every attempt must be made to diminish shock by gentleness, conservation of heat and anæsthetic. A theatre temperature of 75° F. and hot water bags in proximity to the patient are necessary. Careful planning of the details of the operation allow it to be carried out in an unhurried manner in from 40 to 50 minutes. The preparation of the surgical field is important, as added infection may seriously interfere with the success of the graft. The parts should be scrubbed with green soap, then with alcohol, and finally with ether. As a rule local anæsthesia is my choice.

The following solution has proved very useful:

4 Novacaine	.15
Antipyrin	.032
Adrenalin chloride (1:1000)	.26
Distilled sterile water ad 30.	

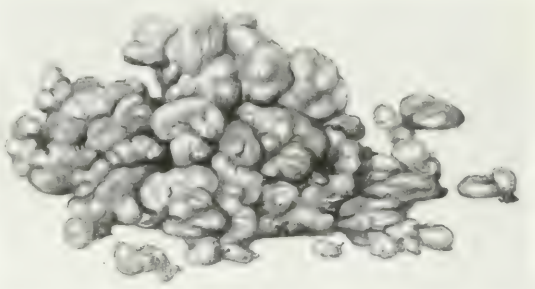

Fig. 10. Drawing by artist of an enormous amount of degenerated tissue, recently removed from the maxillary channel. The patient had several operations performed on this cavity during the past 3 years. After the ultraradical operation and epithelization of the bone, he was discharged as cured within 15 days.

A postnasal balloon instead of a plug of gauze is inserted through the nose and inflated. This is obviously better than using a gauze plug. After the parts are thoroughly anæsthetized, an incision is made at a point a little to the right or left of the frenum of the lip to the second premolar tooth, care being taken to begin well above the gums so as to allow for retraction of the mucous membrane, as difficulty will otherwise be experienced in finally stitching the surfaces together. The periosteum is now freely reflected upward, care being taken not to mutilate it, and it is held out of the way with suitable retractors. The anterior wall of the sinus is hurriedly broken through with a small chisel and the comminuted bits of bone removed. A Coffin suction tube is immediately thrust into the cavity to express blood, secretion, and débris, thus giving an immediate clear operative field. The maxillary opening is freely enlarged in all directions, care being taken not to injure the infra-orbital nerve, thereby preventing weeks of unnecessary agony. The edges of the bony opening are thoroughly trimmed and polished.

The soft parts of the nostril are freed from their attachments, exposing the pyriform aperture. The sinus is carefully inspected and, with the probe, the extent of the infection and the necessity for an ultraradical or radical operation determined. If the former is decided upon, the mucous membrane lining the nasal wall and floor of the nose is freed from its bed. The angle formed by the junction of the anterior and nasal walls is removed along with all of the maxillary nasal wall, thereby making a common opening between the nose and the sinus in front, and thus exposing the anterior superior angle of the sinus. The cavity is freed of all its diseased membrane

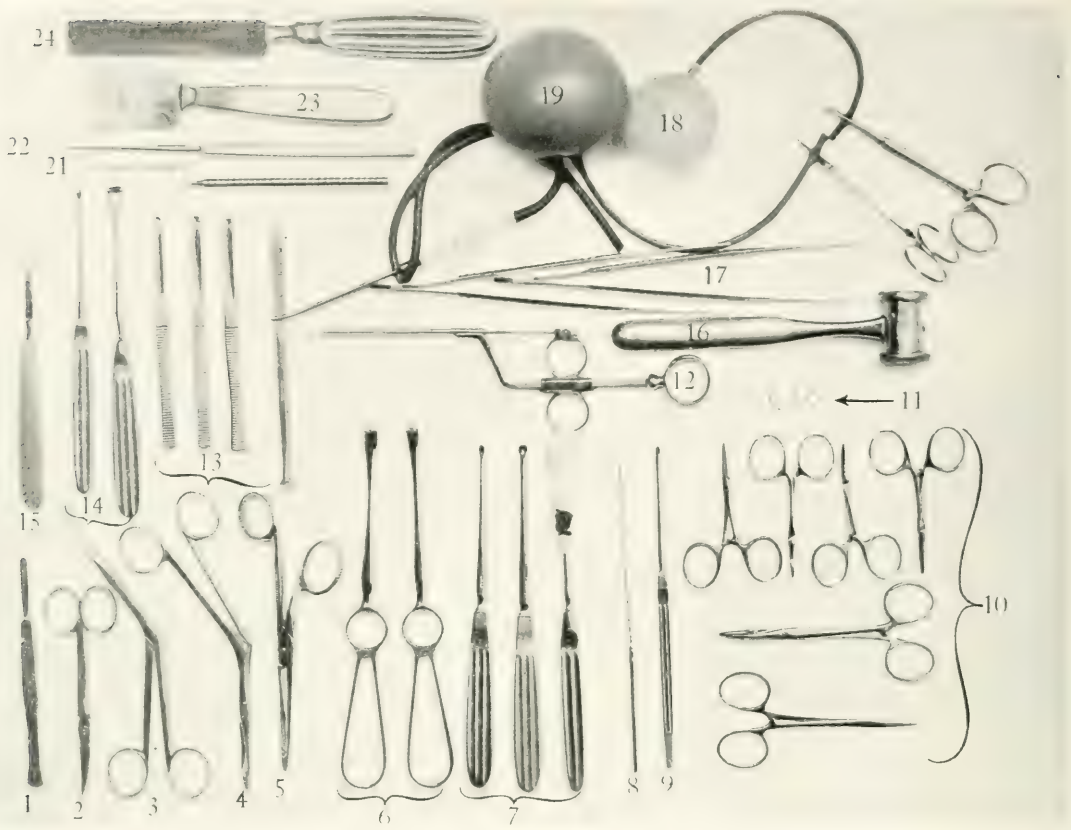

Fig. 11. *1, 9* and *14*, Periosteal and mucous membrane separators; *2, 3*, scissors; *4*, punch forceps for removing adherent tissue; *5*, author's modification of Gillies' suture forceps (see *New York Medical Journal*, April 19, 1922); *6*, pair of retractors; *7*, set of curettes (note one is covered with gauze, as the naked curette is never used in removing diseased tissue from the antrum); *8*, probe; *10*, special artery clamps; *11*, set of needles; *12*, nasal snare; *13*, set of chisels (see *New York Medical Journal*, April 19, 1922); *15*, scalpel; *16*, mallet; *17*, tissue forceps; *18*, antral balloon; *19*, postnasal balloon to act as a postnasal plug; *20*, Ballance suction tube; *21, 22*, author's skin graft spreaders, *23*, skin graft spatula; *24*, author's skin graft knife.

by the use of dry gauze wrapped around a curette. The naked curette is never used because of the possibility of injuring the bone, which may be the cause of infection after the graft is placed over the newly made lesion. The cavity is packed with gauze saturated with adrenalin chloride to insure a dry field. An incision on three sides of a rectangle is made in the nasal mucous membrane, which is thus reflected to the floor of the antrum to act as a lining. If radical operation is to be adopted, the subsequent procedure is according to the method of Caldwell-Luc.

INSERTION OF THE OLLIER-THIERSCH GRAFT

The graft is cut preferably from the right inner aspect of the thigh to include the papillary layer of the corium. If properly cut only a slight amount of punctate bleeding ensues (Davis). The graft is placed upon a metal plate with its raw surface uppermost and evenly spread out. It is then covered with gauze wet in physiological salt solution, until used in the area to be grafted. Several small grafts are placed over the exposed dry bone of the antrum and made adherent with the use of the Ballance catheter. Even and firm pressure upon the engrafted area is assured by inserting a small balloon with catheter attachment through the nose and inflating it to the desired degree of tension. The external wound is closed by suturing with horse hair and sealed with tincture of benzoin. After the fourth day the balloon is deflated and removed through the nose. The sinus is irrigated with 5 per cent solution of magnesium sulphate and dried with

air irregularly until desquamation is complete. Upon inspecting the cavity there is then found a white, even, smooth surface. Elevation of temperature rarely exceeds one degree.

Formerly I used strips of gauze and later pledgets of cotton saturated in Dakin's solution to exert pressure upon the graft. I have now abandoned their use as the reaction in many cases was quite severe and the success of the graft uncertain.

GENERAL RESULTS OF OPERATION

Twenty cases in all, twelve males and eight females, constitute the experience from which these observations have been drawn. In fourteen of these the graft was an immediate success. Of the remaining six, two were subsequently regrafted successfully. These fourteen cases were discharged as cured in from 10 to 30 days. The unsuccessful cases took from 5½ weeks to 4 months to heal. One case developed a very persistent form of osteitis wh ch took quite 3 months to subside. Another had a severe infra-orbital neuralgia lasting 4 weeks in which the patient passed through a stormy and agonizing period.

The fairly large number of unsuccessful cases I attribute to faulty technique. Since that has been improved and we have adopted and perfected the use of the balloon our methods are more assured and our results better.

SUMMARY

The advantages of epithelization of the maxillary recess after the removal of disease are:

1. That the mucous membrane is replaced by skin which assumes some of the function of the membrane.
2. That the formation of scar tissue is prevented.
3. That weeks and possibly months of irrigations are rendered unnecessary.

Fig. 12. Eradication of disease of antrum after the method of Denker. Thiersch graft covering bony surfaces with pledgets of cotton to keep the graft in place. This technique is now abandoned.

4. That the cavity is not packed with gauze and after-treatment is consequently short and not painful, with little local or general reaction.
5. That the skin changes its character after a period of weeks, assuming a pinkish white color.
6. That the patient is returned to a state of health in a comparatively short period of time.

In view of the fact that we are in the realm of experimental work I firmly believe the results obtained are most gratifying and, in concluding this account of my personal experience in connection with the surgery and epithelization of this recess, I desire to record my conviction that, by fair and constructive criticism, you may advance the methods described to you tonight to a stage where complete success will be the average prognosis where they are used.

THE SHARP AND STERILE SCALPEL

By W. WAYNE BABCOCK, M.D., F.A.C.S., Philadelphia

MANY of the methods in use for the sterilization of surgical knives are objectionable, either because they dull the sharp edge of the instrument, require bactericidal measures in which the surgeon cannot have absolute confidence, or are inconvenient. Alcohol is an uncertain germicide, and the stronger non-corrosive solutions, such as phenol, trikresol, formalin-borax, may be prevented from reaching the metal by an air bubble, a film of grease, blood clot, or other material. The boiling of knives for 3 minutes while other instruments are considered to require 15 minutes, is inconsistent. The heating of knives in mineral oil until a sufficient tempera-

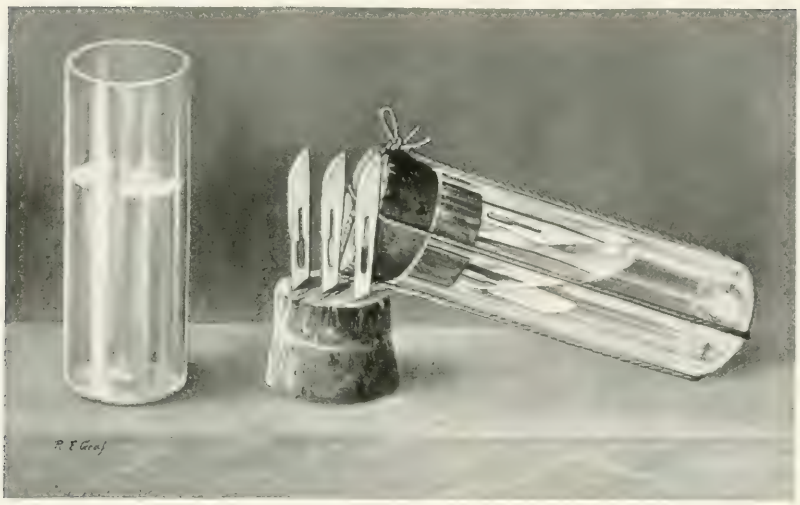

Fig. 1. Author's method of keeping knife blades sterile.

ture is reached, as shown by a thermometer or by the faint smoke given off by the oil, would seem to be more dependable, although requiring greater watchfulness.

For some years we have submerged our scalpel blades in a protective non-corrosive solution and placed them in the sterilizer to boil with the other instruments. Knife blades that have been continuously in the solution for more than 5 years remain bright and sharp, and repeated or long-continued boiling has little appreciable influence upon the cutting edge of instruments covered by the liquid. The solution is miscible with water and is readily rinsed from the instruments. It consists of—

Liquor cresolis compound, 5 parts,
Pure glycerine, 95 parts.

The simplest method of use is to stick the butt end of several Baird-Parker blades in the cork of a wide-mouthed vial nearly filled with the solution, as shown in the illustration. The cork is then firmly tied in, so it will not blow out when in boiling water, and the bottle and contents boiled as required and as long as desired with the other instruments, including the separate knife handles.

Immediately after use, if the blades are rinsed, dried, and replaced in the solution, the cutting edge will be preserved.

The portion of the knife embedded in the cork may become tarnished by the boiling water that penetrates the cork, but this does not interfere with the cutting edge.

More desirable than the glass vial is a steel cylinder or box with a rack to hold the blades, and a water-tight lid or cover. Similar receptacles containing the non-oxidizing solution may, of course, also be used for protecting and sterilizing hypodermic and sewing needles, and other delicate edged instruments.

A "THERMOSTATIC DRIP" APPARATUS

By J. BUCKSTEIN, M.D., New York

A FACTOR of undoubted value in the administration of fluid into the human system, is the conservation of the temperature of the fluid. This is particularly true when fluid is administered intravenously. The simplest and most practical method for attaining this purpose is to employ an inverted vacuum bottle. There is, unfortunately, one difficulty in the use of such a container, that is the fact that, lacking transparency, it is impossible to see just what progress the fluid is making as it leaves the bottle. At no time is it possible to determine the exact level of the fluid or the amount present. This has been a serious objection to the popularization of such a container,

which otherwise is ideal for the maintenance of a proper degree of heat.

It is obviously impossible to create a "window" in the container itself in order to make it transparent. Such an attempt would defeat the very purpose of the container by ruining its "thermos" feature. Therefore, I have employed an indirect method for achieving this result. This has been accomplished by the employment of a gauge, connected with the apparatus as indicated in the accompanying illustration. Based on the fundamental principle that fluid always seeks its own level, it can at once be seen that the level of the fluid in such a gauge will be identical with the level of the fluid within the container itself. By making the gauge of a transparent substance such as glass, it becomes possible actually to determine the exact level of the fluid within the inverted opaque container. Moreover, the value of such a gauge can be considerably enhanced by making graduations upon it, so that each division represents a definite quantity of fluid. This can be done as follows: The container is first filled to capacity and inverted. The level of the fluid in the attached transparent gauge is then marked on a metal extension. As each 10 cubic centimeters of fluid is permitted to flow from the container, a mark is made corresponding to the new level of the fluid within the gauge. In this simple manner, the gauge becomes graduated, so that each division represents 10 cubic centimeters.

Such a gauge enhances the value of the apparatus, not only by overcoming the opacity of the container and practically making it a transparent apparatus, but in addition, because of the graduations upon the gauge it is possible to determine the exact amount present within the container at any time. Also it is possible to determine the rate of flow of the fluid. Thus, if the level of the fluid is originally at the 500 cubic centimeter mark and at the end of 2 minutes, the level of the fluid registers 480 cubic centimeters, it is at once evident that the fluid is leaving the container at the rate of 10 cubic centimeters per minute. It is, therefore, evident that, by means of this simple aid, the graduated gauge, every objection to the use of the opaque vacuum bottle is eliminated. This

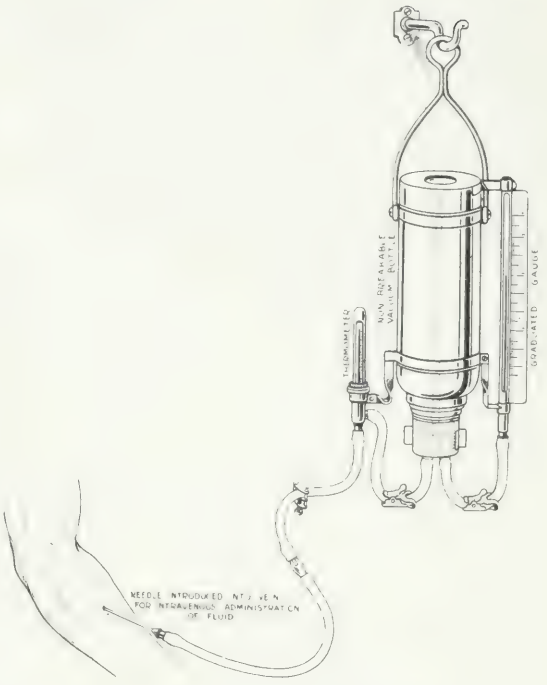

Fig. 1. Device for determining the level of fluid in vacuum bottle.

gauge is protected by metal to minimize breakage. Another advantage in using the apparatus I have devised, is that the temperature of the fluid within the container may be determined at any time. This may be done by placing a thermometer, as seen in the accompanying drawing, so that the fluid as it makes its exit from the container, bathes the bulb, with subsequent registration of the degree of heat.

ADVANTAGES

The advantages of such an apparatus, are these:

1. The maintenance of an even temperature,
2. The registration of that temperature,
3. The visualization of the exact level of the fluid at any time,
4. The determination of the rate of flow.

URETHRAL DIVERTICULA

Report of a Case of Diverticulum of the Posterior Urethra with Stone

By CHARLES P. HOWZE, M.D., Charlottesville, Virginia
University of Virginia Hospital
AND
RUSSELL A. HENNESSEY, M.D., Memphis, Tennessee
Assistant in Urology, University of Tennessee; Attending Urologist, St. Joseph's Hospital

COMPARATIVELY few cases of urethral diverticula have been reported. Ehrlich reviewed the literature in 1908 and found 68 cases to which he added one. Watts presented a study of the reported cases in 1906 and reported one. Haberer, in 1911, added two cases of Finlay and one of his own. Englander reported two cases in 1917 and Bumpus four more in 1919. Watts gave the following classification for urethral diverticula:

A. Congenital.
B. Acquired—
   1. From dilatation of the urethra due to—
      a. Calculus,
      b. Stricture;
   2. With perforation of the urethra, resulting from—
      a. Injuries to the urethra,
      b. Rupture of abscesses into the urethra,
      c. Rupture of cysts into the urethra.

He makes a further distinction between true and false diverticula, stating that the former is a dilatation of the urethra with a mucous lining identical with the part of the urethra from which it springs, and that the latter is the result of urethral rupture, and therefore has a lining of fibrous tissue.

Haberer, in his review of the cases, concluded that but twenty were of the congenital type, the remainder being of acquired type.

The case histories are incomplete and fail in many instances to give the position of the diverticula. Of the reported cases eleven were found in the posterior urethra. We have been able to find thirteen cases in which calculi were found in association with the diverticula. Ehrlich states that they are seldom multiple. Grube found two cases with multiple stones, one in which there were 162 stones and in the other 183.

The etiology of congenital diverticula has been explained by Voillemier as due to a partial lack of development of the spongy tissue of the urethra, and that it is almost identical with hypospadias formation in which there is, in addition, a defect in the skin. Kaufmann ascribes the condition to a failure of the distal and proximal ends of the urethra to unite at the time when the urine begins to flow from the bladder. The proximal end of the urethra becomes dilated, and when finally the union is made the dilatation remains as a diverticulum. Von Grigolow believes the diverticula are due to dilatations of the accessory peri-urethral ducts, which are themselves due to partial defects of the genital gutter. When these ducts enter at a very acute angle into the urethra they form valve-like obstructions which are often responsible for considerable difficulty in emptying the diverticula in postnatal life. Watts believes that some obstruction, as valve formation, congenital strictures, or phimosis, is responsible in some cases.

Referring to diverticula of the posterior urethra Bumpus states that they are probably always of the acquired type. In his report three cases followed perineal operations. He also mentions that traumatic rupture of the urethra with hæmatoma formation, production of false passages by instrumentation, and abscess formation in or about the posterior urethra with rupture into the urethra, as predisposing causes. Grunfeld and Dekeersmaecker hold that a defect in the genital gutter was responsible in their cases. Englander thinks that instrumentation accounts for one of his cases, and that the other was of congenital origin. Watts mentions stone as an etiological factor by explaining that a stone may become engaged and embedded in the wall of the urethra, and with urine pressure behind the stone on the weakened urethral

Fig. 1. Sectional view to show presence of vesical and urethral calculi and diverticulum of posterior urethra.

wall a diverticulum may form. Watts' explanation might seem to find application in our case, but because of the history of gonorrhœa, chills, fever, and acute retention, we are inclined to the belief that it followed the rupture of a prostatic abscess, and that the stone was subsequently deposited from the bladder.

Of the cases reported in which the diverticulum involved the anterior urethra a tumor was found in the majority of cases. This however, does not obtain in diverticula of the posterior urethra. In our case the stone in the posterior urethra could be demonstrated by rectal examination with a sound in the urethra. Since it was lying free in the urethra we feel that it may have exerted a ball-valve action and encouraged the distention of the pocket formed by the rupture of the prostatic abscess.

W. S., colored, single, age 31, occupation plumber, was admitted to the Memphis General Hospital August 28, 1922, because of pain over the lower

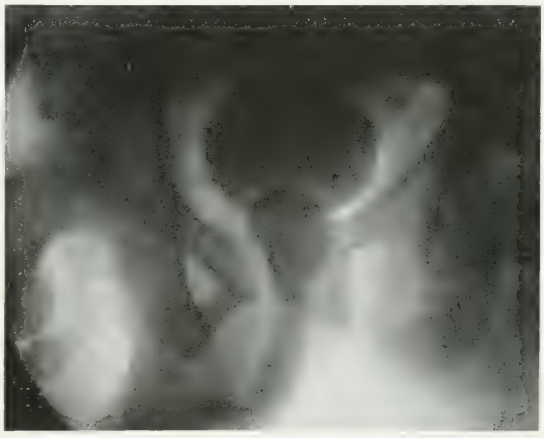

Fig. 2. Cystogram of bladder and of diverticulum of the posterior urethra.

Fig. 3. Cystogram of partially filled bladder with lead catheter coiled in diverticulum.

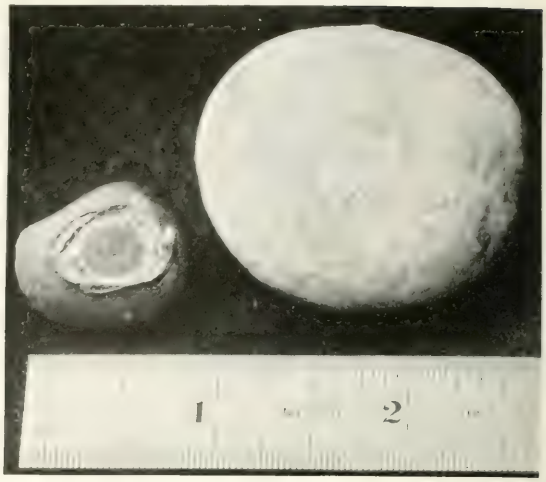

Fig. 4. Photograph of vesical calculus and smaller irregular urethral stone.

abdomen radiating into the penis and perineum, marked pain and difficulty on urination, frequency and lack of force of the urinary stream. He admits having a "strain" when a boy and states that he has had bladder distress since, but that his trouble has become worse in the last few months. At the time of his "strain" he had chills and fever and was unable to urinate until catheterized.

Physical examination showed a fairly well-nourished black male, negative except for pain on pressure over the lower abdomen and a slight urethral discharge. Penis and scrotal contents were normal. By rectum the prostate was smooth and broad; the lateral lobes were firm but elastic; the median furrow was shallow and the tissues in the midline were quite hard. No urethral constrictions were found but upon passing a sound into the posterior urethra a distinct metallic click was elicited. Rectal examination with a sound in the urethra revealed a stone in the prostatic urethra.

Cystoscopic examination revealed a large stone lying free upon the base of a trabeculated and chronically inflamed bladder. Upon withdrawing instrument a second stone was seen in posterior urethra. Vesicle neck was acutely inflamed and bleeding.

The systolic blood pressure was 125, diastolic 85. Examination of a 24 hour specimen of urine showed 900 cubic centimeters; specific gravity, 1024; reaction, alkaline; trace of albumin, no sugar, an abundance of pus, numerous red blood cells, and an occasional hyaline cast. Examination of sediment was negative for the tubercle bacillus and gonococcus but showed colon bacilli and staphylococci. Blood analysis: red blood cells, 4,800,000; leucocytes,8,600; hæmoglobin 80 per cent; Wasserman negative.

A suprapubic cystotomy was done (Howze) and a phosphatic stone weighing 45 grams, (Fig. 4), was removed from the bladder. The internal sphincter of the bladder was dilated and the stone in the prostatic urethra (Fig. 4), weighing 6.5 grams, was removed with some difficulty. Following the removal of the urethral stone, a smooth pouch could be felt extending upward from the posterior urethral wall. The bladder was closed about a rubber drainage tube which was removed on the fifth day following the operation. The convalescence was uneventful, and the patient left the hospital on the twenty-fourth day, with the wound healed.

The patient was seen 3 months later and while greatly relieved continued to complain of some dysuria, frequency, and tenesmus. A second examination was made. Cystoscopy revealed a moderate congestion particularly over the trigone and at the vesical neck. An opening was found in the floor of the posterior urethra into which a lead catheter was coiled. Bladder and diverticulum were filled with sodium iodide and X-rayed to show their relation.

CONCLUSIONS

1. Rupture of an abscess or cyst into the posterior urethra may cause a diverticulum, particularly when associated with an obstruction in the urethra.

2. An especially careful examination of the posterior urethra should be made when the appearance of the bladder does not seem to justify the patient's symptoms.

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EDITORIALS

SURGERY, GYNECOLOGY AND OBSTETRICS

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SEPTEMBER, 1923

REGIONAL ANÆSTHESIA

THE various forms of conduction anæsthesia, from the blocking of the spinal nerve roots by an intradural injection, to the obtunding of peripheral nerves by local infiltration, have fields of usefulness greatly modified by the condition of the patient and the temperament of the operator. While skillful mental diversion, narcotism, light nitrous oxide amnesia, or other expedient may overcome the fears and prejudices of the patient, any of the methods of regional anæsthesia may give the operator a sense of greater responsibility than does ether, may seriously encroach on his time, effect his mental poise, and hamper his activities. It is also true that without a wise selection of the type of anæsthetic for the particular case, the great value of local anæsthesia is largely destroyed.

It is with the bad operative risk that the gauntlet is thrown down to the user of regional anæsthesia. "Will the operation be rendered safer to the patient? Can I operate upon patients considered inoperable with inhalation anæsthesia?" "The patient might endure the operation alone, but could he withstand the anæsthetic?" These are questions which must now be answered in the affirmative. With regional anæsthesia, the surgeon may no longer delay or decline to operate because the patient is a poor anæsthetic risk. The question, "Will I operate with ease and facility" is entirely subordinate to that of the safety of the patient.

When speed and absolute relaxation are required, spinal anæsthesia, with the advantages of instant action, complete muscular relaxation, and associated peristaltic contraction, has the greatest value and also from the depression of the respiration and the great fall of blood pressure which it causes, has the largest potential danger. In the hypotension of shock, hæmorrhage, toxæmia, or asthenia, while the skillful associated use of adrenalized intravenous injections may reduce its dangers, it remains unsafe for general use. In any case, only by the intelligent application of physiological principles, with reference to the drug used, the specific gravity and percentage concentration of the solution employed, the point of injection, the amount of solution injected, the amount of cerebrospinal fluid withdrawn, and the force with which the injection is made, can uniform and satisfactory results be obtained. Modification of any of the points mentioned will influence the height and intensity of the analgesia, the degree of muscular paralysis and relaxation, the respiratory depression, and the associated fall of blood pressure. In brief, the degree of muscular relaxation, completeness of epicritic sensory loss, and the duration of the analgesia, varies directly with the dose, the concentration, and the activity

of the drug employed. For example, the action of 15 centigrams of procaine is comparable to that of 7 centigrams of tropococaine, 6 of stovaine, 3 of butyn. Three centigrams of stovaine give only about 15 minutes of analgesia, 6 centigrams of stovaine, about 90 minutes. Six centigrams of stovine in 4 per cent solution, injected in the upper lumbar region, will usually produce a fall of from 60 to 80 milligrams in the blood pressure, which passes off in 40 to 60 minutes; 6 centigrams of the stronger butyn similarly injected may cause such a complete vasomotor relaxation that the head and chest must be lowered for 3 hours after the injection to maintain a perceptible pulse at the wrist. As the vasomotor centers controlling the upper part of the body are located in the thoracic cord, the effect on the blood pressure depends upon the height as well as the intensity of action of the drug.

Selected in bad risks, the mortality of spinal anæsthesia may easily reach one in two hundred injections, and only by wise selection and very careful supervision may the mortality be reduced to one in ten or fifteen thousand. Fortunately, the later secondary symptoms from spinal anæsthesia, including headache, have been largely overcome by the use of better preparations and the avoidance of dural leakage by using only needles of small caliber.

Sacral, caudal, and paravertebral anæsthesia, while slower and somewhat less certain, and at times more difficult to induce than spinal anæsthesia, avoid the danger of the thecal puncture, usually produce little effect on the blood pressure, and give a very enduring and most valuable analgesia for operation on the pelvic organs, especially for carcinoma of the rectum. Despite the multiple punctures and skill at times required, the safety and slight effect on the general system give these methods an important place in surgery. Splanchnic anæsthesia, induced by deep paravertebral injections or more easily by retroperitoneal injections after opening the abdomen, widens the field of local infiltration anæsthesia for visceral surgery, enabling the most serious operations such as partial gastrectomy, nephrectomy, splenectomy, to be completed in patients hitherto considered too weak to withstand the operation.

Massive local infiltrations by weak, slightly toxic analgesic solutions have a large field of usefulness. The low toxicity, stimulating and enduring action of procaine, when combined with adrenalin, enable one to use such large quantities of the solution that depression, toxicity and dehydration in the patient are combated at the same time that the anæsthesia is produced. No known anæsthetic is so safe in the greatly debilitated patient and in hæmorrhage or shock, the injection may render a blood transfusion needless. The amount of the solution that may safely be employed seems almost unlimited. so that by a "shot gun" injection, effective analgesia without exact anatomical localization is available to the surgeon of average skill. The injection of from one to three thousand mils of the one-fourth per cent solution of procaine containing one to sixty thousand, to one to one hundred thousand parts of adrenalin in Ringer's solution or physiological saline is not only relatively safe, if blood vessels are avoided, but usually will materially improve the condition of the patient, and by stimulating elimination, render the free use of narcotics and sedatives safer than would otherwise be the case. An interilio-abdominal amputation skillfully conducted under local anæsthesia with nerve blocking, is a revelation to any surgeon who does not realize the great field of local anæsthesia. To facilitate intra-abdominal manipulation, an associated heavy

infiltration of the preperitoneal space about the wound is most valuable. As soon as the abdomen is opened, the finger or hand is gently introduced as a guide, the needle repeatedly carried down to, but not through, the peritoneum and 200 to 600 mils of the solution injected. By diffusion, this gives a desirable degree of splanchnic anæsthesia.

In such acute infections as pneumonia, nephritis, peritonitis with a sthenic patient, when the shortest operation with complete muscular relaxation and with the least manipulative exposure or protoplasmic disturbance is desirable, spinal anæsthesia is preeminent. In the depressed, exhausted, deeply toxic, dehydrated, starved, shocked, semicomatose or intensely anæmic patient, spinal anæsthesia is dangerous and massive infiltration anæsthesia with weak adrenalized procaine solution is invaluable. In view of the relatively slight danger from prolonged conduction or infiltration anæsthesia, it is questionable if any operation requiring over 2 hours for its completion should ever be conducted under inhalation anæsthesia alone.

W. Wayne Babcock.

TO THE "STICKS" YOUNG MAN

WHEN a manufacturer selects a site for his plant he considers the source of raw material and the market for the finished product. To the surgeon the patient is both raw material and buyer for the finished product. If we were to follow the logic of the business man we would build our factories for the fabrication of well patients where the raw material is most abundant. The only excuse any patient can have for making long trips to medical centers is that greater talent is available there. It is illogical to collect all the best talent in great groups. Plants here and there, where they are most accessible to those who require such service, would be the solution of the business man. If a state were to be allotted ten high class surgeons by Fate, it would be conducive to efficiency to establish ten stations at opportune points. It would make for the short haul for those able to travel and it would place efficient service within reach of the injured and acutely sick. Unfortunately, there is something repellent to a young man in the thought of going to a small community. There is something belittling in it. It implies that he is not of sufficient caliber to make his way in the city. He argues to himself that he would be deprived of the stimulus of the big medical centers. That is all wrong. Each of us must find his postgraduate school in his patients and his books; the stimulus to work must come from within. The golf course does not develop the finer points of manual dexterity; the grand opera but faintly resembles the murmur of mitral stenosis; and the rudiments only of anatomy can be learned by visiting the musical comedies.

The small town has its compensations. Responsibility and freedom of thought and action are stimulants to work such as cannot be obtained anywhere else. The young man can leave his pride in the city, he will not need it in the country. All he will have there is plenty of work and will soon forget the hypothetical advantages of the so-called centers. The mere fact that the "groups" of medical talents that have in a measure brought the rural "clinics" into disrepute does not argue that such groups would not be a credit if properly manned. The chief argument in favor of this contention is that it has been achieved in many places both to the credit of the medical talent constituting them and to the advantage of the community in which they are located.

Arthur E. Hertzler.

MASTER SURGEONS OF AMERICA

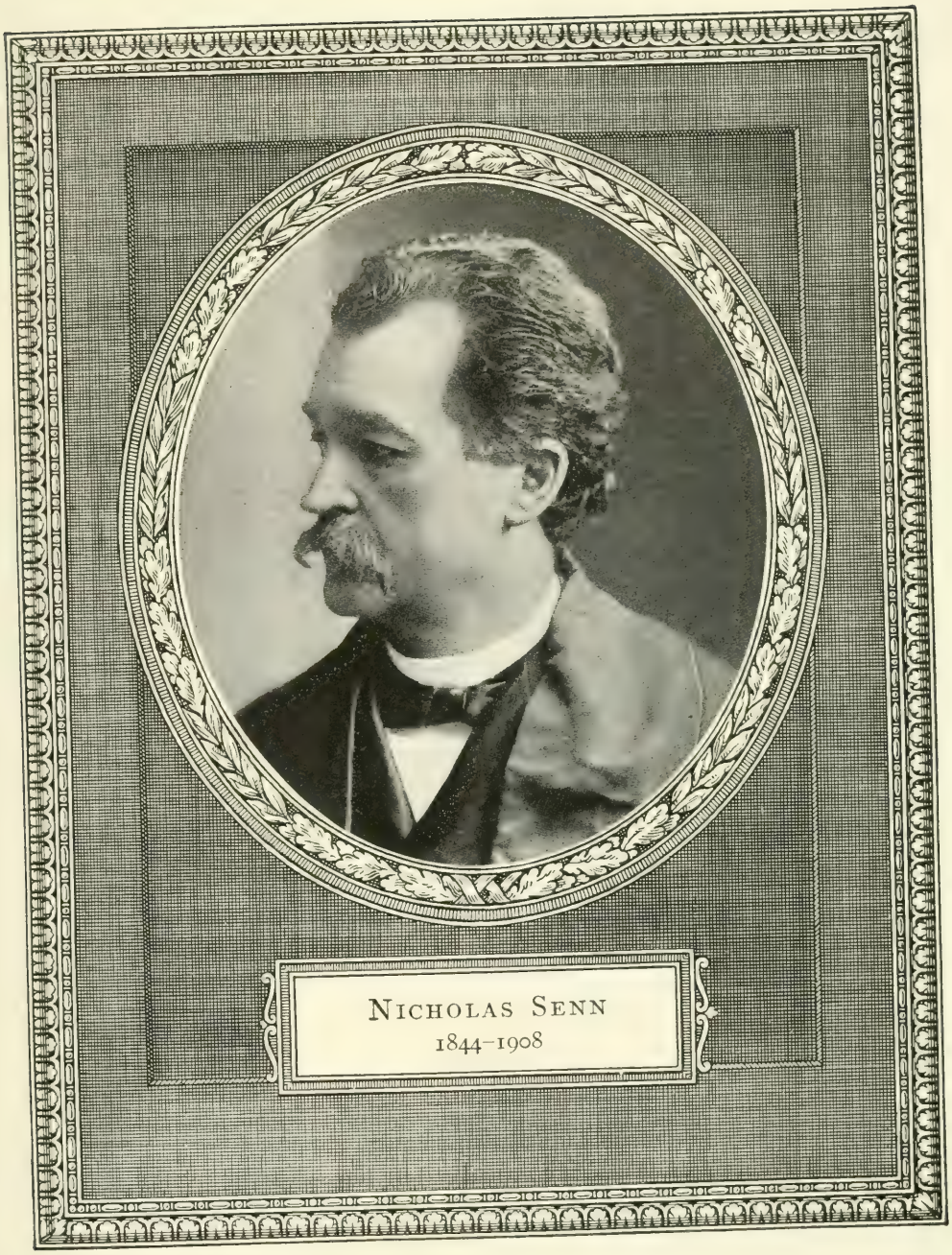
NICHOLAS SENN

IN the earlier and middle part of the nineteenth century, America was still far behind Europe in medical and surgical sciences; but the progress of modern transportation and particularly the settlement of our country with pioneers in arts and sciences have caused rapid strides of advancement, and today we excel in many respects. Without being immodest we may say that the American surgeon ranks very high among his confrères. Progress, however, always rests upon a small number of men of genius. Thus we have in the science of surgery in every epoch and every country, a certain number of renowned men who are the carriers and pillars of this advancement.

Nicholas Senn was one of those men who helped to build up the reputation of American surgery. His name is well known to almost every physician of our times.

What did he do for American surgery? How did he develop to be a pioneer and a leader? He was born in 1842 in Switzerland and came as a child to America, with his parents who settled in Wisconsin. He had all the characteristics of his ancestry, a sturdy, robust body, a clear eye, great courage, and most of all unbounded energy and ambition for work. Work represented to him the stepping stone for success. He was a genuine toiler in the field of science. His education was to a great extent that of an autodidact; at first he prepared himself for a school teacher but soon he found his way into medicine. Dr. Munk, a German doctor of the vicinity where he lived, had a great influence upon the young man: from him he imbibed the desire for study. He began to read industriously and absorbed almost voraciously medical literature; very soon he knew of the classical works of his time, and this knowledge of literature was a great help to him through the rest of his life. Particularly the experiment on animals which celebrated its triumph in those days, was a great attraction for Senn.

After graduation from Northwestern University in 1868 and an interneship in the Cook County Hospital, though he lived in primitive surroundings and had only very simple means at his disposal, he plunged into the field of scientific research and became known as the bold experimenter—on every important question of surgical technique: but feeling the necessity of more and better knowledge, like hundreds of others, he travelled abroad to study in foreign



NICHOLAS SENN
1844–1908

clinics. In Munich where he acquired the title of doctor, it was Nussbaum, and in Vienna, Billroth, who attracted him most, and he bent all of his energies to emulate them. When he returned to Milwaukee in 1874, a larger field for activity awaited him. He became a lecturer and teacher.

Microscopy and surgical pathology were new then—he was an expert in both—and he made daily observations. He became a very active and skilful surgeon whose fame spread beyond the State of Wisconsin. In 1891, the faculty of Rush Medical College called him to Chicago as a professor, and here he came in contact with a great number of students and progressive minds of the faculty. The medical men looked upon him as a great man in the field of scientific surgery and his clinic grew famous and was the attraction of his day.

Fenger, the old Danish surgeon who had an immense knowledge of pathology, was Senn's friend and adviser, and these two men with John B. Murphy, formed the celebrated triumvirate of scientific genius of the Western field of American Surgery. The merits of Senn as a surgeon were in calling particular attention to animal experimentation, to the importance of microscopic diagnosis, and to the progress in surgical technique, particularly in intestinal and bone surgery. Senn's bone plates and decalcified bone chips are well known devices of surgical technique of those days.

Dr. Senn was a tireless worker. I lived next door to him for many years, and often returning at 2 or 3 o'clock in the morning from some patient, I saw him at his desk writing on some medical subject or consulting his extensive library. I would often step into that library at that time of night and I enjoyed listening to his discussion of those very interesting phases of our science or some late advancement and discovery.

He was somewhat of a retiring character, so that only few enjoyed the privilege of being close to him. The amphitheater of his clinic was his Eldorado. One could see how he enjoyed his lecture. In stentorian voice, oratorically and with pathos, he described some pathological condition or disease, and relished the fact that students listened with rapture and admiration.

He also was fond of military surgery. This may have been brought about by his great admiration of those celebrated surgeons of his time who were at the same time great army surgeons. He often spoke on the great Ambroise Paré, of Larrey, of Pirogoff, of Langenbeck, Billroth, and Esmarch, who were his great heroes.

Dr. Senn also loved travel and enjoyed roaming about, going north to Labrador, to South America, and circling the globe by the way of Siberia or Africa, always observing and studying conditions, particularly those of hygiene and medicine. His observations and experiences he wrote down and embellished them with verse and quotations, and personally wrote in long hand many volumes. These manuscripts fill a large wall case in the present Nicholas Senn Library in Chicago, a gift for the profession by him to the Crerar Library.

He left a genuine impression on pupils to perpetuate his work.

In summing up this great man's life, who died at the age of 64 years, and the effect of his life's work upon the American Surgery of today, we must say that he was a stimulus to the younger generation to take up research work and to study pathology. His works (150 volumes), showing what a prolific writer he was, set forth a great many important observations and many great suggestions. Even if some of them did not survive him very long, the name of Nicholas Senn will stand, however, as one of the milestones and pillars in connection with the progress and high standards of American scientific medical work, particularly surgery.

CARL BECK.

BOOK REVIEWS

A CRITIQUE OF NEW BOOKS IN GYNECOLOGY AND OBSTETRICS

By GEORGE GELLHORN, M.D., F.A.C.S., St. Louis, Missouri

THAT in our days of literary overproduction a new book meets an urgent demand, is a distinction to which but few medical works may lay claim. It is in this very select class that Frank's *Gynecological and Obstetrical Pathology*[1] occupies a prominent place. The only two comprehensive works on the pathological anatomy of the female genital organs have been those by Gebhard (1899) and Frankl (1914). In the English language, however, there has existed until now no reference book on this subject which the clinician as well as the pathologist could consult. For this reason alone Frank's book will be warmly welcomed. But it is not only the first of its kind in English speaking countries, it is also a veritable encyclopædia in its completeness. An enormous number of facts widely scattered in the literature of the world has been gathered and classified. To weld this immense amount of material into the comparatively small compass of 500 pages required extensive personal experience, critical judgment, and the gift of clarity and brevity of diction; it, further, demanded restraint in including controversial matter and theoretical discussions, and it may be said at once that the author has fulfilled all these requirements in an admirable manner. The 338 illustrations are almost altogether pictures of miscroscopic sections and for the most part have been drawn by the author's own hand.

The subject matter is grouped according to the various organs of the genital tract, and there are also chapters dealing with obstetrical pathology proper, malformations, the glands of internal secretion in gynecology and obstetrics, the normal anatomy and histology of the generative system and its relation to symptoms and physiological function. In this last-named chapter the variations which occur in response to purely physiological requirements are presented lest they impress the uninitiated as pathological.

To give a few random selections from the book at large, chronic endometritis is pronounced an uncommon disease which, as a rule, is not recognizable under the microscope. In the majority of patients who complain of the conventional symptoms of "endometritis" (leucorrhæa, pain, bleeding, backache, etc.) no corresponding pathological change can be found in the uterus. "Therefore the clinician will be obliged to reclassify the complex of symptoms known as 'chronic endometritis' and distribute them among ovarian functional conditions, diseased adnexa, postpartum subinvolution, etc., where they belong." In cervical polyps secondary changes occur rather frequently which closely simulate carcinoma. In all such cases the examination of the base of the pedicle is of decisive value. It is by no means certain that gonorrhœa is the most frequent cause of salpingitis. Schridde's claim that gonorrhœa produces characteristic changes which are different from acute salpingitis due to other causes, can not be supported. The cells of chorionepithelioma have the destructive properties of the trophoblasts in the earliest months of pregnancy. The ingenious suggestion of Frankl according to which the blood serum of such patients has lost the ability of normal serum to dissolve the chorion cells, is not mentioned. For practical purposes, a thorough curettage is urged after the removal of a hydatid mole, in persistent postabortive hæmorrhages, and in the case of placental polypi. Any recurrence of bleeding should call for a second curettage and if then fetal elements are found in the scrapings, the process should be considered malignant and justify hysterectomy. Even if vaginal metastases and considerable involvement of pelvic structure have occurred, all hope need not be abandoned. Partial removal of diseased tissues has, in several cases, sufficed to cure permanently supposedly inoperable conditions.

These few selections do not do full justice to the rich contents of the book nor do they indicate the numerous original contributions of the author to our special science. This "Pathology" should be in the library of every gynecologist and pathologist.

OF the textbook of obstetrics by von Jaschke and Pankow[2] one can speak only in words of highest praise. Clearness of exposition, beauty of diction, splendid illustrations, and handsome make-up are here combined in a harmonious entity. Extensive theoretical reflections have been avoided, and where mooted questions are still under discussion, personal views and the opinions of others have been given equal prominence. That certain complications, such as contracted pelvis and placenta prævia, imperatively demand hospitalization and

[1] Gynecological and Obstetrical Pathology, including chapters on the Normal Histology and the Physiology of the Female Genital Tract. By Robert Tilden Frank, A.M., M.D., F.A.C.S. New York and London: D. Appleton and Co., 1922.

[2] Lehrbuch der Geburtshilfe. By Prof. Dr. Rud. Th. v. Jaschke and Prof. Dr. O. Pankow. 2d and 3d ed. Berlin: Julius Springer, 1923.

specialistic treatment, can no longer be debated, but the chief aim of the authors has been to emphasize those therapeutic procedures which are within the reach of the practitioner. For this reason the book recommends itself as an eminently valuable guide in general practice. A conservative, yet determined attitude on the part of the physician presupposes a clear conception of the physiological and pathological processes in pregnancy, labor, and the puerperium, and this object has been accomplished in an altogether satisfactory fashion. The extensive bibliographies at the end of each chapter furnish welcome suggestions for more detailed reading.

The study of this book has been to me a source of information as well as of keen enjoyment, and I am certain that all other readers will have the same experience.

WHAT has been said of this "Obstetrics" applies in an even greater degree to the textbook of Gynecology by the same authors.[1] But in addition there are distinguishing features which are not always found in such textbooks. On glancing over the table of contents, the reader will notice that an unusually large space is devoted to "General Gynecology" and on beginning to read—and the reading will presently prove so pleasurable that he is not likely to put the book down soon—that the authors have of gynecology a much wider conception than that of mere organ pathology or pelvic surgery. There is, for instance, a splendid chapter of fifty pages on "The sick woman" wherein constitutional anomalies (infantilism, congenital asthenia, endocrinopathies) and their rôle in gynecological diseases is discussed. In a sub-chapter the interrelations between the genital organs and the other organs of the body are pointed out. In fact, throughout the book there is a consistent tendency to show the effect of gynecological diseases and their symptoms upon the rest of the organism. Conversely, the influence of extragenital factors upon the reproductive organs and the production of gynecological symptoms without local lesions are brought to the attention of the reader.

This does not exclude a very thorough and eminently lucid consideration of the pathology and therapy of the genital organs to which no less than four hundred out of the six hundred pages are devoted. Yet, the attitude of the authors puts an effective check on a narrow and one-sided overspecialization which can see only one set of organs and forgets that these are encased within an organism.

A congenital retroflexion in an infantilistic person, for example, calls for an entirely different treatment from that of a retroflexion in an otherwise healthy woman who has acquired the displacement after childbirth. In the discussion of the causes and treatment of uterine bleeding the traditional but misleading term "chronic metritis" is definitely replaced by "metropathia" in order to emphasize that the local conditions have nothing to do with inflammation. In the question of artificial sterilization the authors practice and teach the greatest possible restraint. In gonorrhœal or septic infections of the adnexa, operation is the method of choice if the symptoms are severe enough; in tuberculous affections, on the other hand, X-ray treatment is superior to surgery. Deep X-ray therapy in general has a wide field of application in gynecology. Of particular interest are the results of radiation in affections which are characterized by intense pain or intolerable itching such as dysmenorrhœa, pruritus, and kraurosis. Non-operative methods of treatment are given greater prominence and more detailed description than is customary in gynecological textbooks.

In conclusion, the work will make many friends on this side of the ocean.

THE surgical technique as taught in the "École pratique"—we would say graduate school—of Paris is embodied in seven manuals covering the surgery of the various parts of the body. The volume[2] before me deals with the operations on the female genital tract and appears as the fifth and completely revised edition. The authors divide their book into three parts comprising, respectively, the surgery of vulva, vagina, and perineum, vaginal operations on uterus and adnexa, and abdominal operations on these organs. For each operation, only the one method is presented which has given the best service to the authors. The description is very good and considers even the most minute details, and this commendable feature is all the more necessary since the illustrations seem to me inadequate to convey a clear conception of the required steps to anyone who has not yet had extensive personal experience. On the whole, the technique recommended is very much like our own, and it is only the nomenclature that strikes us as unfamiliar. Thus, Kelly's bisection of the uterus is ascribed to Faure, the Webster-Baldy operation is named after Dartigues and Caraven, and Wertheim's technique of radical abdominal hysterectomy is credited to Lecène.

Of original French procedures Le Fort's operation for uterine prolapse deserves, according to my experience, more attention than it has found in this country. Vidal's operation for stricture of the tube was new to me; it is an adaptation of the operation for stenosis of the pylorus. In inoperable cancer of the cervix the authors recommend a method of their own.

Through an abdominal incision several catheters with small quantities of radium are introduced beneath the pelvic peritoneum and left in place for 4 or 5 days. It would be interesting to learn of the results of this rather heroic procedure.

[1] LEHRBUCH DER GYNAEKOLOGIE. By Prof. Dr. Rud. Th. v. Jaschke and Prof. Dr. O. Pankow. 3d and 4th ed. Berlin: Julius Springer, 1923.

[2] CHIRURGIE DE L'APPAREIL GÉNITAL DE LA FEMME. By R. Proust and J. Charier. 5th ed. Paris: Masson et Cie, 1922.

TO the discussion, radiotherapy versus operation in cancer of the uterus, Neuwirth[1] contributes a pamphlet of 35 pages in which he analyzes the publications of a large number of authors. His conclusions are: (1) the results of radiotherapy exceed those of Wertheim's radical abdominal hysterectomy; (2) the primary mortality of radiotherapy has been reduced to a negligible minimum while operation is burdened on an average with an immediate mortality of 20 per cent; (3) in women within the reproductive age there is a possibility of later conception as confirmed thus far by three cases in literature; surgical intervention, on the other hand, naturally results in permanent sterility; (4) radiotherapy is free from the psychical and physical shock to which a patient is exposed by operation; (5) the one or two days required for radiation treatment represent a great economical advantage over the weeks and months of convalescence from operation; (6) operation has reached the zenith of technical skill but radiotherapy has before it a wide field of possibilities, both as to its scientific aspect and its technical development.

Assuming for the moment that these conclusions are unassailable, Neuwirth's message to the practitioner might have been more impressive had the diction been more simple and direct, the construction of sentences less cumbersome and involved.

BENJAMIN FRANKLIN has said somewhere: "Wars are not paid for in war-time—the bill comes later." One is reminded of this dictum when reading Otto von Franqué's address[2] on assuming the chancellorship of the University of Bonn. The eminent gynecologist and author takes as his subject the effect of the war in Germany on mothers and their progeny. As to the latter, deleterious influences did not set in until after birth. Only 3.1 per cent of the newborn regained their initial loss of weight during their stay in the hospital. In spite of insufficient breast feeding and inadequate artificial feeding the death rate of the children during the first year of life did not go beyond the respective figures in pre-war times. Between the ages of 1 and 15 years, on the other hand, the war and even more so the subsequent blockade exacted a fearful toll, for the percentage of mortality was more than 50 per cent higher than before the war. Among the survivors, an enormous increase of rachitis was reported from all parts of Germany. The late effect of this disease in the form of contracted pelves will become manifest in from 15 to 30 years and then cause anew a great loss of lives of mothers and children. During the war and the years following, prospective mothers were placed in jeopardy first and foremost by an increase in puerperal sepsis. The death rate from childbed fever rose from 15.6 per 10,000 in 1913 to 27.7 per 10,000 confinements in 1919. In certain parts of the country the mortality rate was doubled. Lacerations and postpartum hæmorrhages likewise occurred in an increased ratio, and insufficient nutrition lowered the resistance against disease in general. Eclampsia was the only obstetrical complication which showed a decided decrease.

The statements contained in this essay merit our earnest attention. They are based on official statistics and are singularly free from any emotionalism. Rather do they breathe a deep ethical seriousness and make us wish for that Utopia which H. G. Wells paints in his *Men like Gods*, where hatred and selfishness has disappeared among human beings and life is held sacred.

WE are accustomed to regard Ignaz Semmelweis as the pioneer in the prophylaxis of puerperal sepsis and to ascribe to Oliver Wendell Holmes a theoretical insight at least into the preventability of that dread infection. In analogy w th other discoveries it might have occurred to us as it did to Horace about two thousand years ago that "brave men were living before Agamemnon," but beyond a few scattered and brief allusions to Levret, Denman, White, a.o., the literature of today dates the beginning of an effectual campaign against the ravages of childbed fever from the labors of Semmelweis in 1847.

It is, therefore, intensely interesting and illuminating to read in Adami's essay[3] that, 70 years before Semmelweis, the first successful attempt at eliminating puerperal sepsis was initiated by Charles White, of Manchester, who in a treatise published in 1773 declared that foul air and surroundings, filthy bedding, and particularly the retention of lochia and other excreta were the principal causes of the "putrid fever." He instituted a number of hygienic measures which are as obvious today as they were revolutionary in his days, and as a result of his practice he was able to say that in his extensive experience of more than 20 years he had never lost a single patient of puerperal fever while all around him deaths abounded through non-observance of the rules which he had laid down.

White himself gave no detailed statistics but among his followers, Collins of the Rotunda Hospital in Dublin could report in 1835 a mortality of 0.53 per cent in 10,785 deliveries, a result which compares favorably with the figures of the most modern institutions in the civilized world.

There can then be no doubt that Charles White deserves a prominent place in the Hall of Fame, and Adami merits our thanks for having presented to us this almost unknown phase of medical history. The full enjoyment of this brilliantly written essay is, unfortunately, marred by the polemic attitude of the author who, in order to extol his own hero,

[1] UEBER DEN ERSATZ DER OPERATION DES GEBAERMUTTERKREBSES DURCH DIE STRAHLENBEHANDLUNG. By Medizinalrat Dr. Karl Neuwirth. Vienna and Leipzig: Wilhelm Braumueller, 1923.

[2] FOLGEN DER KRIEGS- UND NACHKRIEGSZEIT FUER MUTTER UND KIND. By Professor Dr. Otto von Franqué. Bonn: Ludwig Roehrscheid, 1923.

[3] CHARLES WHITE OF MANCHESTER (1728–1813) AND THE ARREST OF PUERPERAL FEVER. By J. George Adami, C.B.E., M.D., F.R.S. London: Hodder and Stoughton, and The University Press of Liverpool, 1922.

seems to feel that he must belittle the work of Semmelweis. Yet, when all credit has been given to his inspired predecessor, the fact remains that it was Semmelweis who clearly saw and proved that the chief source of puerperal fever was septic material introduced *from without* by means of hands, instruments, and other articles, and who paved the way to modern antisepsis and asepsis.

IF Mr. McKay had entitled his book[1] "Lawson Tait and His Times" he would have prepared us in a way for the surprisingly wide outlook he gives us on surgical conditions in England and other countries in the early and mid-Victorian era. Those were the days when gynecology was just being born, when men began to break away from the tyranny of tradition and doctrine, when differences of opinion on medical subjects formed the cause of lifelong personal feuds, and the columns of medical journals were filled with long letters in which the antagonists, in polished phrases, vituperated each other. In the front line of these valiant knights stood a short broad-chested, bulky man with an enormous head and a mane of thick hair. His hands were short and broad and his fingers spatulous; yet they performed wonders of dexterity at the operating table. Such was the appearance of Lawson Tait to whose memory McKay devotes a volume of almost 600 pages. We follow his hero from his student days in Edinburgh in 1860, through a life filled to the brim with fruitful work, to his death in 1899. We see him as the hand of a loving and admiring disciple paints him, as a seeker after Truth, an indefatigable worker, a dauntless pathfinder into unexplored fields, a man of whom our own William J. Mayo said that "the cavities of the body were a sealed book until the father of modern abdominal surgery, Lawson Tait . . . carried the sense of sight into the abdominal cavity." That McKay is fair enough not to stamp his Master a saint but admits the narrow prejudices, the pugnacity, the foibles which Tait shared with other strong men, only adds to the value of the biography; and we are even made to realize that Tait always had an eye to business, as we would say nowadays.

Of particular interest to us is Tait's own account of his trip to America in 1884 in which he summed up his observations in the statement that "no Englishman can obtain a reasonably full grasp of how the world is moving, or of the numerous phases of life, medical and surgical, as well as others, until he has seen life across the Atlantic." This was not his only contact with our country. He had numerous personal friends among American surgeons, for instance Marion Sims and VanderVeer, and among the many surgeons who came from foreign countries to see his work, there were a great many from this side of the ocean. In fact, he was so overrun by Americans that he gave instruction to his footman not to admit any "Yankee doctors."

In writing Lawson Tait's biography, McKay has rendered us a distinct service. His thoroughness in dealing with his subject, his painstaking care in presenting collateral data, and a number of excellent portraits and other plates make this volume an important document which will be welcomed by all lovers of the history of abdominal surgery and gynecology.

OF making many textbooks there is indeed no end. Hence the essential requirement of any new book is that it prove its right to exist. It is doubtful whether this recent work on pediatrics[2] adequately justifies its existence. The enormous mass of pediatric material presented, plus the mass of distinguished editors, has resulted in a book lacking clarity and unity,—a compendium which has got out of hand. Editorial comments are so inextricably mingled with original text, that the attempted addition of more recent contributions results only in the confusion of the reader. This, probably more than anything else, is responsible for one's occasional sense of surprise that the work was produced as recently as the year 1922.

From the point of view of the obstetrician, the chapters on anatomic and physiologic peculiarities, mortality and morbidity, and diseases of the newborn are decidedly helpful. Being largely statistical, and less susceptible of various points of view, the confusion which mars the other chapters is much less in evidence. In the chapter on hereditary syphilis—of interest to obstetrician and pediatrician alike, the difficulty of extricating editorial comment from original text takes a ridiculous turn. On page 783 we are told to continue treatment for 14 days after symptoms of syphilis have subsided (!). On page 785 the American editor very properly sets a minimum of 1 year for infants, and 2 years for older children, regardless even of serologic effect.

I venture that the obstetricians and pediatricians who will read or who have read this book will agree that their time would have been better spent upon other obstetric or pediatric literature.

P. J. WHITE.

[1] LAWSON TAIT, HIS LIFE AND WORK: A CONTRIBUTION TO THE HISTORY OF ABDOMINAL SURGERY AND GYNECOLOGY. By W. J. Stewart McKay, M.B., M.Ch., B.Sc. New York: William Wood and Co., 1922.

[2] TEXTBOOK OF PEDIATRICS. Edited by E. Feer, translated and edited by J. P. Sedgwick, B.S., M.D., and C. A. Scherer, M.D., F.A.C.P. Philadelphia and London: J. B. Lippincott Co., 1922.

AMERICAN COLLEGE OF SURGEONS

SCIENTIFIC MEETINGS AND CONVOCATIONS IN SOUTH AMERICA

IN the course of the *Vandyck* Cruise to South America, formal medical meetings were held in three of the principal East Coast cities, namely, Rio de Janeiro, Buenos Aires, and Montevideo. At these meetings the members of the College wore the Fellowship robe, emphasizing the official significance of the gatherings. The audience in each instance was constituted of members of the local medical profession and medical students, Fellows of the American College of Surgeons, and other passengers of the *S. S. Vandyck*. Everywhere the spirit of professional brotherhood was manifested by the unlimited hospitality, courtesy, and kindness which was shown to the Fellows of the College from North America by their southern confrères.

CONVOCATION AT RIO DE JANEIRO, BRAZIL

The scientific meeting and Convocation in Rio de Janeiro was held in the brilliant Palace of Festivals on the Exposition Grounds at nine o'clock on the evening of Thursday, March 8, 1923. Dr. Miguel Couto, President of the Academy of Medicine, presided, and with him on the platform were several prominent Fellows of the College in Rio de Janeiro, the officials of the College, and the essayists of the evening.

At the conclusion of the address of welcome by the President of the Academy of Medicine, he conferred upon the Acting President and the Director-General of the American College of Surgeons the Honorary Fellowship of his Academy, and presented to each of them a handsome medal as tangible evidence of the honor.

This was followed by the formal program, which included papers on surgical subjects by Dr. José de Mendonça, of Rio de Janeiro; Dr. F. N. G. Starr, of Toronto, Ontario; Dr. Fernando Vaz, Rio de Janeiro; and Dr. John Osborn Polak, of Brooklyn, New York, the text of which appears on pages 408, 410, 412, 414, respectively.

The distinguished Dr. Olympio da Fonseca, General Secretary of the Academy of Medicine of Rio de Janeiro, was presented for Honorary Fellowship in the American College of Surgeons by the Director-General. The candidate was received by the Acting President, who, by virtue of the power vested in him by the Board of Regents of the College, conferred upon Dr. da Fonseca the honor for which he was presented.

FORMAL MEDICAL MEETING AT BUENOS AIRES, ARGENTINA

At five o'clock on the afternoon of Saturday, March 17, 1923, the Fellows of the College and other passengers of the *S. S. Vandyck* assembled in the auditorium of the Faculty of Medical Sciences in Buenos Aires for the scientific meeting and Convocation, which was conducted under the presidency of Dr. José Arce, the eminent Rector of the University. Members of the local medical profession and medical students were of the audience, and filled the hall to its capacity.

At the close of his address of welcome, the Rector called upon the Director-General of the American College of Surgeons. Dr. Martin thanked the Argentine medical profession, in behalf of the College, for the cordial reception which it had accorded to the scientific brethren from North America, after which he presented for Honorary Fellowship in the College "the distinguished Dr. Marcelino Herrera Vegas, President of the Academy of Medicine and the Surgical Society of Buenos Aires; Member of the Royal Society of London; literateur, savant, philanthropist, linguist, a citizen of international affairs, whose distinguished family laid the foundations of a great Republic." The Honorary Fellowship was conferred by the Acting President of the College, and acknowledged by Dr. Herrera Vegas as follows:

> Although I understand that the ceremonial used in your College in cases such as this is very simple and short, so much so that the honored recipient has scarcely time to answer the allocution addressed to him, I ask your permission to break with this laconism for once and beg you to concede me a few moments in which I may reply to your kind and friendly words, and also express the feelings which flood my whole being and compel me to make you my very deep acknowledgment.
>
> Personally I have a special reason for venturing to ask your indulgence in listening to me. You all know that I was called by you to different meetings of your College, in Philadelphia, in Montreal, and again in Boston, to receive the title of Honorary

Fellow of this institution, since an article of the by-laws forbids the conferring of Honorary Fellowships *in absentia*. Unfortunately I could not attend any of these meetings for private and very painful reasons that forced me to desist from making the journey, and to renounce the intimate pleasure of being admitted in your friendly and hospitable country, which I last visited nearly 30 years ago. Today, thanks to a number of happy events, most agreeable for us all, many Fellows of the College are assembled in these precincts, and the presence among them of the Acting President of the Board of Regents has made it possible for me to be formally admitted.

So I have come, as you with your friendly courtesy, which I very fully appreciate, have wished, to take part in this assembly and receive the diploma that accredits me an Honorary Fellow of the American College of Surgeons. This honor, as great as it is unexpected, is far above my poor merits; and I accept the distinction, which crowns in a very special manner my academic career, in the knowledge that it is addressed not to me individually, but through me to the University of Buenos Aires, in which I have been only a modest collaborator. The diploma you have just conferred on me is a most precious object which will occupy a place of honor, and it will never cease to bring back to me the memory of this historic assembly, formed of some of the foremost masters of American surgery of today.

I assure you this ceremony has moved me most deeply and has stirred me to the depths of my heart. It is taking place on a spot made sacred to me by the memory of many records and remembrances of my happy and gay boyhood hours, and now, with the visions passing before me of my old teachers to whom I owe so much, and my good companions, many of them fallen in the battle of life, I am living again in a flood of intimate reminiscences.

Most welcome you are, illustrious representatives of the American College of Surgeons and thereby of our great Northern sister, whose wonderful progress, especially during the last century—*still far from ceasing*—has surpassed all expectations, even the most optimistic. For me the greatest thing realized by your people, in whom have been remolded far over the seas the Latin and Saxon races, is the harmony of your development, culminating in an equal success in every path to which you have turned your steps. The vast areas of your territory, extending from the Pacific to the Atlantic oceans, and from the cold lands of Alaska to the torrid zone of Florida, crossed by great rivers and mighty mountains, are closely populated by one hundred and twenty million inhabitants, and are covered with the most populous cities of the world. Your people has created a powerful navy and a well trained army that have crossed the seas to carry the "Stars and Stripes," covered with glory, alongside the flags of the allies through the beautiful fields of France.

But above all this it has advanced artistic and scientific culture in a most admirable degree, and has spread throughout the territory of the States its hundred and fifty universities for teaching—and for more than teaching, for the development of civic virtues, ideals, and character; in a word, to quote a great American thinker, "*to form a clear mind.*"

This cruise, which has been guided by the hand of fortune, will be an outstanding milestone on the path of the scientific life of both countries. It also represents a transcendental mission of lofty educational culture, strengthening the moral bonds that link us and giving us an invaluable mental exchange, especially as regards the study of the improvement of mankind's physical and spiritual health, the work of the ever-growing science to which you have devoted your lives. And with this mingling of our minds, striving to learn one another's intellectual character better, shall we make still firmer the ties that bind together these two Republics of each extreme of this new continent—a continent whose peoples Providence has appointed to take allied action in realizing the great ideals of peace, fraternity, and love, in these sad moments in the history of mankind.

But even yet, after those great events that have shaken Europe to its foundations, in which your country gave, together with its sons, workers for the eternal ideal, the moral power of its name to the service of Justice and Liberty—even yet it does not seem that Iris will shine out in the sky and disperse those banks of black cloud, heaped up by Bellona; still we look in vain for the wise Minerva, bringing in her hand her symbol of the green olive branch. Faced by this uncertain future, when people even fear for civilization itself, all eyes are turned to these fruitful lands of America, whence will arise a new race and a new civilization, bringing an era of lofty ideals that shall raise humanity to heights of perfection never before reached.

Only one sad note sounds in our ears in this harmony of happiness and pleasure, and that is the remembrance that your stay among us will be all too brief; how it brings home to us Goethe's wish, that we could but delay the happy hours and keep you longer at our side.

I thank you, Doctor MacDougall, and all you my very good friends, for your courtesy and your goodwill, which with the merited prestige of your names add such splendor to this meeting—a meeting that will remain an ineffaceable memory in the annals of this house. You will, I hope, have formed new ties of friendship in this country, which I am sure will add a new charm to your life, bringing you a remembrance that neither time nor distance can weaken or efface.

One request I have to make of you, and then I have finished. It is that when you arrive again in your country you will give my warmest and most affectionate greetings to Doctor William Mayo, one of the pillars of modern North American surgery. To him, and to Doctor Martin, whose presence among us today it is our good fortune to enjoy, do we owe the inspiration of these happy scientific cruises

which have done, and will do, so much good service to the cause of closer and warmer relations between our two great democracies.

To you all I say in the old language of Green Erin, "Cead míle fáilté." (*Cad mili falta.*)

An abstract of the lecture by Dr. Hugh H. Young, of Baltimore, and a translation of the paper read in Spanish by Dr. James T. Case, of Battle Creek, Michigan, are given on pages 415, 417.

MEDICAL MEETING IN MONTEVIDEO, URUGUAY

In Montevideo, a formal medical meeting was held in the assembly hall of the Faculty of Medicine at nine o'clock on the evening of Friday, March 23, 1923. Dr. Alfredo Navarro, president of the Society of Surgery of Montevideo, presided.

Dr. Navarro delivered an address of welcome in Spanish, which was translated into English by Dr. Nin y Silva, of Montevideo. Scientific papers were presented by four of the Fellows of the American College of Surgeons from North America. A translation of the paper read in Spanish by Dr. Case, appears on pages 419–420. Dr. A. J. Crowell, of Charlotte, North Carolina, spoke on "Removal of Ureteral Stone by Cystoscopic Manipulation; Disintegration of Cystin Stone by Pelvic Lavage and Internal Medication," the text of which may be found on page 112 of the July, 1923, issue of SURGERY, GYNECOLOGY AND OBSTETRICS.

An abstract is given below of the talk by Dr. R. D. Kennedy, of Globe, Arizona, on "Tendon Transplantation in the Forearm Following Irreparable Injury to the Musculospiral Nerve"; also on "Sarcoma of the Upper Jaw," by Dr. John F. Barnhill, of Indianapolis, Indiana.

DR. RODERICK D. KENNEDY, of Globe, Arizona: Where the injury is above the branches to the extensors of the wrist, the pronator radii teres is transplanted into the tendons of the extensors of the wrist. After these have been drawn up sufficiently to hold the wrist in dorsiflexion, the flexor carpi radialis is transplanted into the three extensors of the thumb in as straight a line as possible from its origin to its new insertion. This transplant is done after the extensors of the thumb have been drawn up sufficiently to hold the thumb in extension. The flexor carpi radialis is transplanted into the extensors of the fingers in as straight a line as possible from its origin to its new insertion after the fingers have been extended, and the extensors drawn up sufficiently to hold them in extension. The skin incision is made so that it will not superimpose over the point of transplant of the tendons. The hand is put up with the wrist, fingers, and thumb extended on a cock-up splint and maintained in that position for about 3 weeks before any active movement is tried.

DR. JOHN F. BARNHILL, of Indianapolis, Indiana: Sarcoma is common, especially in the young. Since the disease may begin in the maxillary sinus, the posterior wall, or nasal wall, and therefore be concealed until far advanced, a late diagnosis has been made in the past. On this account operative statistics are woefully inaccurate. Early diagnosis is absolutely essential to cure. Textbooks even yet picture the appearance of the jaw as wholly indicative of the final stages, and writers continue to detail the later symptoms essential to recognition of the disease, and therefore diagnosis is too long delayed.

The rhinologist should examine these cases at a time when they are first suspected of disease. By skill and the use of all known plans of investigation, he should be able to detect the presence of the disease in its incipiency. Operation at such a time is hopeful. Deformities are obviated because at this early stage of sarcoma the disease may be widely removed and yet leave supporting portions of the jaw. Better statistics depend wholly upon early diagnosis, and better diagnosis must depend upon earlier and more skilful cavity examination.

ACTUAL CONDITIONS AND INDICATIONS FOR LOCAL ANÆSTHESIA

By JOSÉ de MENDONÇA, M.D., F.A.C.S. (Hon.), Rio de Janeiro, Brazil

As a member of the American College of Surgeons, the great association and instrument of scientific intercourse and friendship among American peoples, I bid you welcome; and as a Brazilian physician, I thank you for your kind visit and hope that you may have a very happy trip through South America.

In spite of the marvelous progress which has been made in the science of medicine and surgery during recent years, anæsthesia remains an oppressive influence to operators and patients. Although anæsthesia was welcomed as a gift from heaven after centuries of pain, it was followed almost at once by cases of immediate death of young and apparently healthy persons, caused by the use of ether or chloroform.

The surgeon has become more confident in the use of anæsthetics because of the improvement of the technical procedure, the multiplicity of anæsthetics, the research into their toxic effect, the invention of new and complicated apparatuses, the specialization of those who administer narcotics, and the practice of a previous laboratory examination to determine the efficiency of the emunctories and the use of correctives against the toxic effect of the various general anæsthetics discovered up to this time. But we are far from being able to guarantee life to those who subject themselves to narcosis in order to undergo an operation which very often is insignificant.

This pertains to the tragic death during or immediately following the operation. Those who have spent many years in the practice of surgery know that the greater number of victims is not among these, but, rather, that the majority slowly and fatally succumb from intoxication on the second to the fifth day because the anæsthetic has a fatal influence on some organ essential to life.

Because anuria is a very apparent symptom, it was declared at first that the degeneration of the kidneys was the cause of the disaster; later the incontrollable vomiting seemed to result from liver insufficiency; and, finally, the low blood pressure and the disturbance of the heart brought into evidence certain stimulating, depressing, or coordinating organs by means of internal secretion. Be that as it may, in spite of so much practical and theoretical progress, the fact still remains, unshaken in its tragic significance, that in many cases the organism is so sensitive to general anæsthetics as to become intoxicated by them.

Local anæsthesia appeared as a ray of hope. A drug was discovered which was capable of temporarily interrupting the function of the nervous tissue, abolishing one after the other, as the doses were increased, the senses of pain, of temperature, and of touch, even, to a great extent, the motility. I refer to the marvelous effect of cocaine.

It was in 1884 that Koller explained before the Congress of Heidelberg the surgical importance of this drug, and from that time up to the present, the European and American surgeons, some of whom are present at this assembly, have never ceased in their efforts to render local anæsthesia the saving resource of those who, in the last stage of organic debility, find it necessary to undergo an operation.

Thanks to these efforts, we have at hand a method more inoffensive than any other known, capable of anæsthetizing all parts of the body without alarming disturbance to the great and essential functions of life—a method which spares the mind and vigilance of some senses but leaves the patient in a state of consciousness. The technique of this method is at present much more simple than that of general anæsthesia, and allows the surgeon to give his whole attention to his special work. It precludes thought of accidents arising from the anæsthetic, suppresses the inhibitory reflexes, permits immediate nourishment, and leaves the patient perfectly calm as soon as the operation has been completed. It is a method which contributes to the welfare of the patient and eases the conscience of the surgeon; but it is harmful to our social influence as it suppresses the emotional scenes of surgical liturgy and so takes away our prestige as terrible angels who torture for the benefit of creatures and of creation.

Regarding the technique, we have at hand nearly all of the requirements which are necessary in order to generalize the method. We have an anæsthetic which, when used in a dose not strong enough to produce for one and a half to two hours any toxic accident, allows us to render large parts of the body insensible and to operate on a clear field, even in regions largely vascular, such as the extremities, the mouth, the anus, etc. I refer to novocaine dissolved in physiological serum and combined with adrenalin.

Numerous processes of anæsthesia, used individually or in combination with others, facilitate the application of the method to the most complicated surgical cases.

A simple embrocation produces superficial anæsthesia, which permits of an examination of the patient and slight interventions, principally as they pertain to the minor specialities; but it renders to major surgery the important service of suppressing uncomfortable or even fatal reflexes, as, for instance, gulping during the removal of the upper jaw, and spasms of the larynx and the inhibitory reflexes of breathing during the dilatation of the anal sphincter.

Nearly all surgical operations may be performed without pain and with the least possible loss of blood through the process of infiltration by means of a syringe and needles of various lengths, whether this is done directly to the tissues of the part to be operated upon or whether the region is enclosed by infiltrating around it.

Infiltration anæsthetization of the nerve trunks and plexuses through the skin, enables the surgeon to pursue a certain number of surgical interventions, but without the benefits of hæmostasis.

Spinal anæsthesia with its variations—lumbar, thoracic, and cervical—is likely to produce partial or total analgesia and permits of unlimited surgical intervention; but it has no influence on hæmostasis, according to some surgeons even seeming to favor blood losses. Esmarch's bandage is seldom, if ever, used as an aid in injecting the anæsthetic into the veins or arteries.

Let us now consider the value of these proceedings as they pertain to the field of action, efficacy, facility of execution, and possible accidents.

Embrocation is at present limited, efficacious, easy to perform, and free from accidents when utilized in a strictly technical way.

The favorite anæsthetic is cocaine, combined with adrenalin.

Anæsthesia of the nerve trunks is little used and serves rather as an aid in the process of infiltration; it requires not only a perfect knowledge of anatomy, but ability as well, and extensive practice. It is certainly efficacious when an operation is to be performed in the center of a part supplied by the nerve. On the periphery, however, the variety in the distribution of the nerve fibers renders analgesia uncertain. Traumatic neuritis, which may last one or more months, may result.

Five to twenty cubic centimeters of a 1 per cent solution of novocaine-serum-adrenalin is sufficient to produce this condition.

The effect of spinal anæsthesia may be extended to the entire body, and it is efficacious in almost all cases. The technique is simple and within the reach of any operator. However, it must be admitted that very serious and inconvenient accidents sometimes occur. Among the immediate ones we may mention distress, vomiting, vasomotor disturbance, and syncope, with a momentary or definite cessation of breathing and pulse; later accidents are headache which cannot be relieved even by the lumbar puncture, various degrees of paralysis, and temporary disturbances of certain reflexes indispensable to the normal functioning of some emunctories.

Finally we reach the process by infiltration which, thanks to the latest progress in technique and the possibility of anæsthetizing the splanchnic nerves, may be applied to any part of the body with true efficacy and is extremely easy of execution, for it only requires a general knowledge of the direction in which the nerves run and the manner in which the anæsthetic will spread. That is, the spaces bounded by the skin, the aponeurosis, the bones, and serous membranes. Surely the process is safe which uses solutions so diluted (½ to ¼ per cent) of a drug six times less toxic than cocaine and combined with adrenalin which localizes its effect and strengthens the heart.

Immediately following the use of larger doses, some of the patients manifest chills, with stronger heart-beats, but with undisturbed breathing.

This lasts only a few moments. As a later accident I have only observed, during the 13 years I have used the method, a momentary elevation of temperature (37.5 to 38) within the first 48 hours, and paræsthesia which lasts from 1 to 3 months.

It is easy to understand why infiltration is gradually taking the place of spinal anæsthesia and narcosis when it is considered that in addition to the aforementioned qualities this process has the added advantage of keeping the field of operation bloodless, of avoiding previous hæmostasis and loss of time in drying the wound, of precluding accidents caused by the flow of blood in the trachea, and of preventing collapse due to hæmorrhages which frequently occur in certain operations performed under general anæsthesia, such as removal of the upper jaw and of nasopharyngeal polypus.

If it were only necessary to abolish pain to enable one to operate in complete tranquillity, all operations, whether major or minor, could be performed under local anæsthesia; but the calmness of the patient is an important factor in the performance and the results of the operation.

The operator must influence the patient through suggestion, win his confidence, and turn his attention in every way from the operation. This constitutes local anæsthesia an inferior practice as compared with narcosis, and another intermediary method—anoci-association—so well studied by Crile. While it may be inferior in some cases, it is never contra-indicated, except in agitated, insane, or extremely timid people, nervous children not easily pleased or tempted, and in patients who are to undergo certain laparotomies where the extent of the injuries cannot be calculated.

It is beyond understanding why an attempt is being made (under pretext that the injections may cause metastasis) to remove cases of septicæmia and pyæmia from the jurisdiction of local anæsthesia, particularly when it is possible to inject healthy tissues or the nerve trunks that serve the part to be operated on. These patients, if subjected to any other anæsthesia, must undergo surgical manœuvre, which is more apt to lead to the consequences which are feared.

The same is true of the scars and œdematous regions which, due to resistance to the spreading of the anæsthetic, would render anæsthesia ineffective were it not possible to surround the part by injecting the neighboring tissues.

Setting aside the contra-indications above mentioned, it may be affirmed that, after the later progress obtained, local anæsthesia should be the

method of choice, giving place to anoci-association and to narcosis when peculiar conditions belonging to the clinic case render local anæsthesia inconvenient.

The simplicity and sureness of local anæsthesia allowed Kulenkampf to use it in 24.6 per cent, Laewen in 49.92 and Hartel in 60.05 per cent of the cases on the battlefields during the World War. When doctors shall have become familiar with this sovereign resource, which appears to the author to be the most important victory since the advent of antiseptics, this percentage will continue to rise until it covers nearly the whole field of our surgical activity.

RESULTS IN GALL-BLADDER SURGERY

By F. N. G. STARR, C.B.E., M.B., M.D., C.M., F.A.C.S., Toronto, Ontario

IN studying gall-bladder disease, it is necessary to make clear that "gall-bladder disease" does not necessarily mean "gall stones," because the formation of stones is merely an incident associated with gall-bladder infection, plus inflammation. There are so many phases of inflammation of the gall bladder that it is necessary to approach the treatment from two standpoints: first, as a life-saving measure; and, second, from its economic aspect.

I. LIFE-SAVING MEASURE

Acute inflammation without jaundice. The patient may or may not recover spontaneously, with but little trace of the disease, though later in life gastric symptoms may develop from adhesions and a gradual fibrosis of the duct.

Acute inflammation with cystic duct obstruction without jaundice may result in a large cystic gall bladder which, sooner or later, will require surgical intervention.

Acute inflammation with rupture of the gall bladder is a rare condition as in our experience it occurred but three times in 450 cases. In this series we have also had four cases in which anastomosis occurred between the gall bladder and duodenum with a resulting intestinal obstruction in one and in another an obstruction at the duodeno-jejunal junction produced by a mammoth stone that could not get through the opening in the transverse mesocolon.

Acute inflammation with so much associated thickening of the duct as to produce obstruction with jaundice.

Acute inflammation with common duct obstruction from stone, giving rise to jaundice.

If a suitable time is chosen, these cases largely reduce themselves into acute imperative conditions demanding surgical intervention, and in such the question always arises: Should drainage be instituted or should the more radical procedure be followed? The method of choice must depend largely upon the condition of the individual patient. Each case demands the most careful surgical judgment.

After all, the first essential is to relieve pain, and the second to save life. A brilliant operation, followed by a funeral a few days later, reflects no credit upon surgery. It is infinitely better to save a life with the possibility of a further restorative operation in the future.

II. THE ECONOMIC ASPECT

Distressing symptoms should be relieved, such as pain under the right costal border, or in the epigastrium associated with the tenderness over the lower dorsal roots. Oftentimes the patient volunteers the information that he fears to take a long breath because of the discomfort it causes him He often complains of the distaste for food or nausea at the sight of food, due no doubt to an associated pyloric spasm. Others do not wish to partake of food because of the consequences, the distress coming on within an hour after eating. In a large percentage of the cases, distress depends upon the kind rather than the quantity of food taken, it being caused by fats, fried food, and certain vegetables. The large majority complain of gas on the stomach, and many (32.4 per cent) suffer from constipation. Of these, 72 per cent were entirely relieved by the removal of the gall bladder. Diarrhœa is present in very few cases, but when it does occur discomfort in the upper abdomen precedes the attack. In one of our studies, 29 per cent suffered from mucus in the stools. In these cases we found a staphylococcus aureus in the gall bladder and of them 65.2 per cent have been entirely relieved of the so-called "mucous colitis."

In this type of case we must endeavor to increase our efficiency, and we must further seek to prevent later complications such as—

1. The acute conditions formerly mentioned;
2. Chronic pancreatitis;
3. Hæmorrhagic pancreatitis;
4. Carcinoma resulting from the continued irritation.

METHOD OF PROCEDURE

Having arrived at the decision that the patient is suffering from gall-bladder pathology, the question naturally arises: How shall we proceed? A few

cases will develop an economic efficiency under a strict diet régime, associated with a mild laxative and an anti-spasmodic. If operation is decided upon, there must be careful preparation. Any preliminary purgative must be given several days before the operation. The patient should then be given all of the nourishment he can assimilate as well as all of the fluid he can take. Oftentimes it is well to give him a glucose and soda solution, either by the Murphy drip or intravenously, as the case may require. In some semi-starved, anæmic patients, a preliminary blood transfusion will assist in carrying them safely through the ordeal of a serious surgical procedure. If there is jaundice, 5 cubic centimeters of a 10 per cent solution of calcium chloride, given intravenously each day for 3 days prior to operation as suggested by Walters of the Mayo Clinic, will overcome the danger of hæmorrhage.

As an anæsthetic, the open ether method is to be preferred as it is all-important to secure perfect relaxation which makes possible the gentle handling of the viscera. After a trial of practically all of the incisions recommended, the author has settled down to a right rectus, near mid-line, incision, beginning close to the right of the ensiform cartilage, thus affording sufficient room to work comfortably and at the same time to produce a wound that will lend itself readily to healing and to the production of a sound abdominal wall.

Lest in the preliminary examination some latent pathological process may have been overlooked, it is the practice to explore the stomach, duodenum, and pancreas, as well as the ileo-cæcal region, for sometimes it is essential to deal with some further gastro intestinal pathology in order to secure the best result in the patient.

In dealing with the gall-bladder pathology itself, the first procedure is to explore the ducts carefully, and if there is a stone in the common duct, or if there is a thickening of the duct associated with a moderate amount of pancreatitis, the common duct is opened and the stone, if present, removed. Then a No. 6 gum and elastic catheter is passed through the ampulla for some distance into the duodenum. This will tire out the spasm of the sphincter, and, if need be, will serve as a means by which nourishment can be carried into the duodenum during convalescence.

The cystic duct and artery are then isolated as far away from the common duct as possible, and clamped in a double clamp. They are then cut across. A suture on a fine needle is passed between the duct and the artery and securely tied beyond the end of the forceps. The suture is then continued two or three times around the clamping forceps, and the transfixion of the duct made certain. The forceps is slipped out and the suture tightened and tied. The needle on this suture is then passed through the fold of peritoneum which can be brought up. and as the gall bladder is dissected out of its bed, the peritoneal fold can be caught on each side until the gall-bladder fissure is completely closed with a smooth peritoneal coat. If, however, the gall bladder is deeply buried in the liver and a rough surface has resulted, a free omental graft is cut and laid in the fissure, where it is secured by means of the free ends of the suture behind as well as in front, thus obviating the formation of subsequent adhesions.

If it has been necessary to put a catheter into the duodenum, the other end is brought out of the abdominal wound and may serve as a drain. If the wound is otherwise clean and dry, drainage is seldom introduced except in the presence of active infection.

The abdominal wound is then carefully closed and the posterior rectus sheath secured, whereupon the toilet of the operation is completed. When the patient is taken to his bed, he is put on a Gatch frame with his shoulders elevated, and a Murphy drip of glucose and soda solution is immediately started. In the first 6 ounces of this solution, we put from 1 to 2 drams of concentrated tincture of digitalis, since if this is done the patients do not suffer afterward with tachycardia, nor are they subject to postoperative distention or to chest complications. As soon as the patient is sufficiently awake and complains of pain, he is given morphine in an amount that will make him comfortable and produce sleep.

In order to secure the best postoperative results, it is essential to have these patients report from time to time for at least a year, so that slight defects may be remedied and that they may obtain the best possible result.

To recapitulate:

1. If gall bladder surgery is instituted soon after the first symptoms develop, the mortality is negligible;
2. The disaster of complications is avoided;
3. The efficiency of the individual as an economic asset is improved, as about 66 per cent of these patients are cured, and 34 per cent are relieved of most of their symptoms.

WHAT THE AMERICAN COLLEGE OF SURGEONS HAS DONE FOR THE SURGEONS OF RIO DE JANEIRO

By FERNANDO VAZ, M.D., F.A.C.S., Rio de Janeiro, Brazil

AMONG the hospitable countries, Brazil proudly occupies one of the first places, and, in most cases, those who visit it do not feel ill at ease in spite of its enormous territory and the difficulty of its almost unknown tongue. Among its inhabitants, mutual trust is proverbial. Those who have had the privilege of visiting the inland, and have had occasion to have personal dealings with our farmers, know that no one knocks at his door, asking for food, lodging, or information, who is not received with open arms and treated with entire disinterestedness. The Brazilian, as a general rule, gives what he has without expecting any return. This natural trait of those who live in the interior is transmitted, without any change, to its centers of greater culture, where, in spite of material progress, selfishness, which dominates a great part of humanity, does not always find lodgment.

If you will take the trouble to look into our history, you will have occasion to verify the truth of this statement. You will see, for instance, that those who govern us have a tendency to side with the weak and the oppressed. They refuse many times the possibility of great compensation, so as to be on the side of justice and right.

What is the cause of such a tendency?

It is because Brazil has always lived surrounded by people whose chief object in life has been cordiality. From its beginnings as a nation it has tried to be a defender of peace and in favor of great ideals, maintaining among its inhabitants mutual confidence, which is indispensable to mutual understanding, as also to the progress of the country.

It is this sentiment that we Brazilian physicians zealously cultivate, perhaps more so than any other class of workers. This is the reason why the majority of Brazilian physicians place above their own personal interest the health of their fellow beings, and maintain the profession at the highest possible standard of professional honor.

Our physicians and surgeons count it a great pleasure to be able to prove to those who as yet do not know them this quality of character in their profession, which, to speak candidly, is only a reflex of a general trait in our race.

In expressing this fact to you, my dear colleagues, you who understand the nobility of such an ideal, our hearts overflow with legitimate pride in finding ourselves in your company, you, whose greatness of soul has such a close affinity to ours.

Whatever be the prism through which one looks at your actions, altruism is always your dominant characteristic; and those who know you well, know that in your country those who suffer do not fear adversity, because your millionaires do not forget to divide of their abundance with those less fortunate.

None among us but has heard of the lavishness of Rockefeller, or of the work of Peter Bent or Robert Bent. If we tried to mention other cases, it would be very difficult to choose who should have the preference. As proofs of your altruism, it is only necessary to call attention to your universities, your colleges, and your hospitals (both in the homeland as well as abroad, and of which we, in Brazil, have such visible proof in the great Baptist institutions, so nobly fostered among us).

This is the reason why we feel at home with you. We bid you welcome, gentlemen, to this land of proverbial hospitality.

Every time good friends come to see us, or other countries send to our shores some special envoys who represent the glories of their country, we feel under obligation, and if unable to return in any other way, we try at least to express our sincerity in words. You may be sure that if your presence in this hall is a great pleasure to all Brazilians, it is a yet greater pleasure to the one who is at this moment addressing you.

Never can I forget your country, the kindness of your people, and your simple life, both of teachers and pupils. I never would have attempted to speak to you in your own language, were it not for the great friendship that I feel toward you. In your country, instead of the oligarchies full of disdain that unhappily still exist in some scientific centers, there prevails a powerful democracy, where all may be sure of finding a place according to their personal merits, be their origin or position what it may.

Your presence here is certainly a great satisfaction to me. I cannot but speak again of the personal interest manifested by William Mayo, one of the most prominent men of your country, who, after a visit to our part of the world and hearing of our presence at his clinic, received us with his characteristic courtesy, and inquired particularly into the real conditions of our life, about our schools, our men, and our science. Upon leaving his home I was sure of having done a great service to my country, offering to that eminent spirit the seed that is now bringing forth fruit.

Since then I have followed closely your program. Your efforts in remodeling the hospital service demand the united forces of each and every one in the marvelous work which you are planning to do.

There is no need for us to speak of the powerful influence that the surgery of your country has had upon us. In this country, as well as in other countries, your names are highly esteemed. There is no Brazilian surgeon who has not heard of the work

of Howard Kelly, whose value as a scientist is recognized in all of our books, and whose technical knowledge cleared the ground in matters of gynecology. The writings of Charles and William Mayo on gastro-intestinal surgery; of Young on surgery of the prostate gland; of Cushing on surgery of the hypophysis and of the auditory nerve, are true milestones that will make their names honored through future generations.

I now wish to present to you the little that I have been privileged to do.

In our private practice, I try to introduce all the improvements that are at our disposal. Although we do not have the riches of some of your clinics, as we depend entirely on our personal resources, yet we have the means necessary for good surgery.

We are as yet not able to show you a model hospital, active in all of its various departments; but I wish to show you one that is just now beginning, and for which I have been doing my utmost, planning to introduce there all the good things that I saw with you. I refer to the Surgical Department of the Hospital of San Francisco de Penitencia, which will be built in one of our best suburbs, in the mountains of Tijuca. The land has a frontage of 240 meters, and is a plateau extending along the mountains. The building will occupy the first elevation, and will measure 90.90 by 73 meters.

In the left wing a complete section will be given over to baths, rooms for massage, for mecano-therapy, for X-rays, and so on; in the right wing will be the store-room for surgical materials, the office, pharmacy, and the quarters for internal service; in the center will be stationed the stretchers.

The first floor will be reserved for septic surgery, and will have in each wing three wards, each containing ten beds, one ward for specially dangerous cases, and at each end recreation rooms.

On the second floor there will be an extensive circular gallery that will communicate with a special gallery enclosed with glass, reserved for aseptic operations and accessories. There will be found baths, a room for preparing the sick for anæsthesia, sterilizing room for the physician, surgical arsenal, and room for all the necessary articles and accessories for sterilization for the whole hospital, and also the office for the head nurse of the surgical department; at the side, small wards for the cases recently operated upon, private rooms, dining rooms, etc., etc.

The third floor will be reserved for laboratories, museums, library, and refrigerating apparatus for cooling the operating rooms.

Besides this, in the hospital of San Francisco de Assiz, where it is our privilege to direct the general surgical service for women, a great number of improvements have been introduced, due to the opportune initiative of the illustrious director of the Public Health Department, Dr. Carlos Chagas. In that institution, where each surgeon is permitted absolute autonomy in the exercise of his clinic, a school for nurses has recently been established under the direction of American nurses. Miss Kienegen, one of your country women, the head nurse, is doing her utmost, so that before long we may have a goodly number of graduate nurses. Then, also, a perfect and systematic examination of all anatomo-pathological material of the hospital is made in the laboratories of the Institute of Manguinhos, where, as you know, we have a group of capable anatomo-pathologists.

In this movement we are not the only ones, for, before long, you will hear of other similar undertakings, promoted by colleagues who are residing in this metropolis as well as in other parts of Brazil.

If to all of this we should add that both our federal and municipal governments are thinking seriously about the hospital problem of this city, for which your example has been such a powerful incentive, you will have a more succinct idea of what constitutes our program.

As you will readily see, the program of the American College of Surgeons, of which you are such worthy representatives, has been one of the subjects of our daily thought. With the objective in view of elevating still more the surgical profession, you try to introduce uniformity into your service. Uniting under the same flag what you have of the best in your profession, promoting in your clinics the autonomy necessary to a conscientious surgeon, you offer, to those who trust their lives into your hands, all of the advantages of a timely and efficient surgical intervention.

Working in the midst of a complete organization for the study of the sick, you awaken in the professors the desire for greater progress, and in the students, love for and dedication to the profession they have adopted. Placing yourselves in condition to practice applied surgery, on the basis of pathology, hygiene and physiology, you offer to those who desire your services real lessons in those things in life, the influence of which tells upon the medical profession in general.

It is not necessary to emphasize the sublimity of your ideal, nor the finesse of your generosity in extending, even beyond your frontiers, the benefits of your efforts. Calling into your guild the whole family of American surgeons, and trying to organize them into one strong and powerful body, the objective of which is to work on behalf of suffering humanity, you give once more an example worthy of imitation. Your initiative eliminates from American surgery the excessive centralization that has been so prejudicial to every good movement in medicine. Your College, with its great prestige, will enable all to combine in one strong, intelligent, and willing effort. You can, therefore, rest assured that you will find here our heartiest support in the task which you have undertaken.

I would like to say a great deal more, but the time allotted to me will not permit.

CONSERVATISM IN ACUTE PELVIC INFECTIONS

By JOHN OSBORN POLAK, M.Sc., M.D., F.A.C.S., Brooklyn

A BETTER understanding of the physiological pathology in pelvic lesions, and the more minute study of the habits of bacteria and of the tissue reactions excited by the entrance of the several forms of pathogenic bacteria, have done much to swing the pendulum toward conservatism in acute pelvic infections.

In arriving at a prognosis and in determining the treatment in acute pelvic infection, it is just as necessary to know the avenues of entrance, the type of bacteria, and the tissues involved as it is to know the time and place of starting when one is about to undertake a railway journey, for bacteria commonly keep to the beaten track. They reach the pelvic tissues through a point of entrance, an abrasion, or wound by way of the lymphatics, through the placental site, or along the mucous membrane of the cervix, uterus, and tubes.

The common types of bacteria in puerperal infections are the streptococcus, the staphylococcus, occasionally the pneumococcus, and the gas bacillus of Welch. In non-puerperal infections, the gonococcus alone, or the streptococcus alone or in combination with the gonococcus, are the exciters of tissue reaction.

The whole process of normal labor is so arranged that it is combative of infection. The natural division of the utero-vaginal tract at the internal os into an infected zone below and a sterile one above is well known. The mucous plug occludes the cervix until labor begins. The membranes, when intact, protect the amniotic cavity from upward migration of bacteria. The outflow of liquor amnii with its downwash of fluid temporarily cleanses the passage. The rotary scrubbing of the cervix and vagina by the oncoming child further displaces the migrating bacteria. The inversion of the placenta through the rent in the membranes protects the placental site, and finally the bacteriocidal character of the lochia in the first few hours after delivery form some of the safeguards with which nature protects the woman and which are seldom thought of by the accoucheur. Hence, unless bacteria are carried into the sterile zone and inoculate a wound, nature is competent to offer the necessary resistance.

How then does infection occur?

1. By the introduction of bacteria through traumatisms of the cervix;

2. Through inoculation of the great uterine wound itself;

3. Through the placental site when the contraction and retraction of the uterus are defective.

When inoculation occurs, the bacteria always excite some degree of reaction in the tissues invaded. Wounds of the cervix are the most common points of entrance in all hurried labors or in prolonged dry labor, with or without instrumental interference, and it is in the surrounding connective tissue (the parametrium) that the reaction is found. How effective this reaction is, depends upon the virulence of the infection and the individual reaction of the tissues. Virulent infections give the patient no chance to establish her immunity.

When the bacterium passes through a wound in the cervix into the parametrium, an exudate is poured out into the connective tissues surrounding the cervix; while if the great endometrial wound is inoculated, a protective wall of leucocytes is formed, and small, round tissue cells are poured into the basal membrane as a defense against the invading cocci. On the other hand, if the infection succeeds in reaching the peritoneum, a plastic exudate seals off the pelvic cavity by adhesions of the bladder, sigmoid and omentum. Thus does nature attempt to isolate the pelvic cavity, limit the infected area, and render the invader harmless.

How may these natural pathological processes be aided by surgery?

A clinical study of numberless puerperal lesions shows that surgery can be of little assistance; but the effectiveness of these protective processes may be furthered by certain conservative measures and so contribute to the resistance of the individual—

1. By the proper conduct of labor;

2. By the avoidance of trauma;

3. By observance of the strictest asepsis;

4. By avoiding vaginal examination and following the progress of labor by abdominal palpation and rectal touch;

5. By conservation of blood loss;

6. By securing proper contraction and retraction of the uterus;

7. By postural drainage, which contributes to this contraction and retraction;

8. By supportive treatment, the normal functions of the body being continued by maintaining the cardiac action and the blood pressure. This may be done by stimulation, the exhibition of fluids, and by small, repeated blood transfusions.

Only when the infection is still within the uterus, in the endometrium, can any surgical measure be of value; and when anything is done, care must be exercised not to disturb the physiological pathology that is going on. An effort should be made to secure the following objectives:

1. Perfect retraction and contraction of the uterus;

2. Perfect uterine drainage;

3. Sterilization of the uterine cavity.

In puerperal endometritis, with a profuse, fetid lochia, an open cervix, uterine pain, and a relaxed, soft, tender uterus, these ends may be attained by

the use of the Ill tube and iodoform gauze drains with alcohol instillations. When, however, the infection enters the blood stream, whether it does this by lymphatic extension or by the direct introduction of the bacteria into the blood stream, it becomes a fight between the bacteria and the leucocytes. If the bacteria win, they multiply and produce a bacteriæmia; on the other hand if the leucocyte kills the bacteria, the patient makes a slow recovery.

To summarize, it may be dogmatically stated that in acute puerperal infections surgery should be confined to incision and drainage of cul-de-sac or parametrial abscesses or drainage in spreading peritonitis. None of the radical procedures such as curettage, hysterectomy, or ligation of the pelvic veins are justified in the light of our present pathological knowledge.

In acute infections of gonorrhœal origin, it may be broadly stated that active surgery has no place in their treatment. For the gonococcus is a selective organism, attacks the mucous membrane, and travels by continuity either on the mucous surface or by the lymphatics in the basal membrane.

Certain foci such as Skene's urethral tubules, the racemose glands of the cervix, and the fallopian tubes become the final resting places for the Neisser bacillus, where it remains latent for indefinite periods or dies as in the tubes when the ostia becomes sealed. If the tube becomes sealed at its fimbriated end, the gonococcus dies in from 6 weeks to 3 months, provided rest and conservative methods prevail.

The ovary in pure gonorrhœal infection is seldom involved, though it may be buried in protective adhesions; hence we have come to feel that if we are to conserve the menstrual and ovarian functions in an infected woman, our best course is summed up in four words:

1. Rest;
2. Cleanliness;
3. Postural drainage;
4. Time.

You will ask: How long shall we wait before operating?

1. Until all exudate is absorbed;
2. Until the temperature has been normal night and morning for 10 days or 2 weeks;
3. Until the white blood cell count is below 11,000 and, finally, until pelvic examination or menstruation fails to excite an exacerbation. Then destruction of Skene's ducts with the fine point of the electric cautery, excision of the infected glandular portion of the cervix, and simple salpingectomy will rid the woman of every focus of infection and yet retain for her menstrual and ovarian functions.

In conclusion, clinical experience has taught us that in operating for pathological results of infection, each case should be reviewed as to the history of the infection and the location of the remaining lesion, for only in this way is it possible to decide what were the causative bacteria, which will aid us in determining the course which should be followed.

THE IMPORTANCE OF THE PERINEAL ROUTE IN DISEASES OF THE PROSTATE AND SEMINAL VESICLES

By HUGH H. YOUNG, M.D., F.A.C.S., Baltimore

THE perineal route is important as an approach to the prostate, not merely in hypertrophy, but also in carcinoma, tuberculosis, calculus, chronic infections of the vesicles as well as the prostate, and various operations for incontinence, recto-urethral fistulæ, impermeable urethral structure, and rupture of the deep urethra.

Success in the various operative procedures which are required to combat these conditions depends, first of all, upon a clear conception of the anatomy and physiology of the region; and, second, sufficient operative experience to recognize the successive fascial and muscular structures. Much of the criticism of the operation of perineal prostatectomy, and the bad results obtained, are due to ignorance.

If hypertrophy of the prostate were the only surgical problem to be dealt with in this region, surgeons might be content to do only suprapubic prostatectomies and remain in blissful ignorance of the finer anatomical and technical features of the perineal route; but, as stated above, there are many other important prostatic diseases which demand surgical relief, and which can only be reached satisfactorily through the perineum. The conscientious surgeon who essays to give proper surgical care to all such cases cannot longer ignore the perineal approach to the prostate, or fail to perfect himself so that he may carry out skilfully the operations needed for the cure of these various important diseases.

The first complaint against perineal prostatectomy, incontinence of urine, can be avoided by opening the prostatic space back of the triangular ligament and external sphincter. The anatomical details were described in a recent paper by the writer in Surgery, Gynecology and Obstetrics for April, 1923 (1), and it will suffice to say here that it is only necessary, after a curved incision in front of the anus, to open up, by blunt dissection, the space on each side of the central tendon behind the transversus perinei muscles, thus pushing backward the two levator ani muscles. The central tendon is then divided close to the bulb, and beneath it the recto-

urethralis muscle is sectioned tranversely close to its anterior attachment to the membranous urethra, after which the rectum, thus freed, can be easily retracted backward.

The next important item of technique is to recognize the posterior layer of Denonvilliers' fascia, where it covers the apex of the prostate, on each side of the median line, and, by dividing it, expose the pearly white posterior surface of the prostate. Then following upward, by blunt dissection between these two layers of fascia (in fetal life peritoneum), the entire posterior and lateral surfaces of the prostate, seminal vesicles, and base of bladder are exposed, ready for any of the radical surgical procedures necessary to attack diseases of this region.

This conservative approach has not only done away with the fearful sequelæ of the old blind median perineal section, but has opened up a vast new field to surgery.

Briefly, the salient technical features of the operation for perineal prostatectomy, and the advantages of the method, are: the avoidance of blind surgery, all stages of the operation being visible; the resultant greater conservation-preservation of ejaculatory ducts and internal sphincter; the thorough control of hæmorrhage; the better drainage, dependent and short; the simpler, quicker convalescence; the lessened danger of infection and abdominal complications. This was exemplified by the report of 1049 cases with a mortality of 3.4 per cent, in the last 198 cases of which there was not a death. In this series of 198 consecutive cases there were 58 patients over 70, and 6 over 80 years of age, showing the safety of this perineal operation.

Because of the frequency of cancer of the prostate (20 to 25 per cent of enlarged prostates), I would urge the importance of early diagnosis and radical operation. This procedure can be carried out with ease and thoroughness, thus removing in one block the entire prostate with its capsule and urethra, the neck of the bladder, the seminal vesicles with the overlying two-thirds of the trigone, and the ampullæ of the vasa deferentia. The remaining defect is easily repaired by anastomosing the wide-open bladder with the stump of the membranous urethra, and by the recent modification of technique, which preserves the nerves, blood vessels, and fascia in front of the prostate, avoids incontinence of urine, and secures perfect bladder (2).

The prostate is a well-encapsulated organ, and it is not surprising that among the 20 patients on whom this operation has been performed, the apparent permanent cure is well over 50 per cent.

In more advanced cases the perineal route also offers an opportunity of inserting radium points—either emanation in glass or 1 milligram of the salt in platinum—into the depths of the prostate seminal vesicles, base of bladder, and adjacent tissues. When there is little or no obstruction present, the urethra is not opened; in other cases the obstructions, generally concomitant hypertrophied lobes, are enucleated. The results obtained by surgery and radium in many cases have been remarkably satisfactory functionally, and sometimes curative.

The third subject is tuberculosis of the prostate and seminal vesicles, which recent studies (4) have shown to be involved in nearly all cases of seminal or genital tuberculosis. The ultimately high death rate in cases where epididymectomy or castration had been carried out, shows the importance of removing the seminal visicles and lateral lobes of the prostate. By means of the long urethral tractor and the employment of the same technique, except that the urethra is not opened, the bladder can be so depressed that a splendid exposure is obtained, and the seminal vesicles, along with the lateral lobes of the prostrate, may be removed in one piece with the deeper portions of the vasa deferentia, the remainder of which are removed through the groins with the tuberculous epididymis or testicle. By this procedure, the entire seminal tract, with the exception of the terminal portion of the ejaculatory ducts, is radically removed, and the results obtained, even in 5 cases in which a tuberculous kidney, also present, required removal, have amply justified the procedure.

The recent work of MacFarlane Walker, demonstrating that genital tuberculosis is almost always secondary to infection in the seminal vesicles and prostate, fortifies the arguments advanced for radical surgery in these serious cases.

Chronic infections of the seminal vesicles, which so often lead to grave septicæmia endocarditis and arthritis, require perineal operations, incision and drainage, or very frequently excision as completely as tuberculosis. Seemingly miraculous recoveries are sometimes obtained by such procedures (5).

Time does not permit discussion of the various other important perineal operations which are required to attack the diseases, malformations or traumatisms which cause great distress. They simply add to the *raison d'être* of perineal surgery, and the obligation which hangs heavily upon all who would conscientiously undertake the care of these cases, to master the anatomy, physiology, and surgery of the perineum.

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THE VALUE OF BEDSIDE X-RAY STUDIES IN THE IMMEDIATE POSTOPERATIVE MANAGEMENT OF SURGICAL CASES

By JAMES T. CASE, M.D., F.A.C.S., Battle Creek, Michigan
Battle Creek Sanitarium

WE cannot refrain from expressing our great appreciation of the honor we have in addressing so distinguished an audience of American surgeons—an audience which is truly all-American. The American College of Surgeons is an all-American institution, including in its Fellowship surgeons from practically all of the Republics on the American Continents, and the Dominion of Canada. As Pan-Americans, we are proud to be here, and gratefully to acknowledge the wonderful hospitality which has been extended to us.

As a surgeon-radiologist, I wish particularly to pay special tribute to such brilliant Argentines as Lanari for his work on the differential diagnosis of hydatid cyst and sarcoma of the lung; Heuser for his book on radiology; and Carelli for his notable contribution on perirenal emphysema.

This afternoon I wish to discuss the very great value of the roentgen rays in the postoperative management of patients after abdominal operations. Time does not permit more than mere mention of the therapeutic value of radiation in the postoperative treatment of malignant and tuberculous disease, and in the management of hyperthyroidism, either as an aid to surgery or in some cases replacing surgical operation. Neither have I time to discuss the value of fluoroscopic control in the accurate application of radium in œsophageal carcinoma after gastrostomy, or in many cases before resorting to gastrostomy; in carcinoma of the rectum or rectosigmoid, especially when the performance of inguinal colostomy permits the introduction through the disease-bearing area of a string with which to draw the radium into place under screen control. Roentgenograms are useful in controlling the accurate placement of radium-bearing needles as a prophylactic, or in the treatment of primary or recurrent uterine carcinoma with extension into the broad ligaments, and in certain cases of prostatic carcinoma.

Following operations upon the stomach or duodenum, not infrequently symptoms occur which give rise to some degree of anxiety lest an obstruction should have supervened. Such an accident, following gastro-enterostomy or cholecystoduodenostomy, may be early recognized by radiological study at the bedside following the administration of a very small amount of opaque salt (not over 10 to 15 grams) in plain water—a procedure which in our hands has never produced untoward results. Such a temporary obstruction of a spasmodic nature usually responds promptly to the use of the duodenal sound, and it is here, in the accurate placing of the duodenal sound, that fluoroscopy again renders important assistance.

For any patient who cannot be moved from the bed, bedside studies may now be easily performed with a portable apparatus which is universally available. The portable roentgen apparatus is simply wheeled to the patient's bed, a roentgen plate-holder placed underneath the patient, or at his back or chest, as he lies in the appropriate position, and the exposure of 3 to 10 seconds is made while he holds his breath.

It is especially interesting to make postoperative studies following gastro-enterostomy. Not always does the new opening function in a satisfactory manner, although the patient may recover sufficiently to leave the hospital. Careful screen study, particularly on such a useful fluoroscopic table as has been devised by Carelli, will quickly determine in which position the stomach empties most readily: whether erect, prone, supine, or lying upon the right or the left side, or in some combination of these positions; and the patient may then be instructed to assume this optimum position for a given length of time after each meal until the stomach learns to accommodate itself to the new conditions.

After operations on the intestine, with anastomosis, as after resection of a portion of the bowel, the roentgen study offers adequate explanation of many untoward results. Especially is this true when, after an ileosigmoidostomy, intestinal contents back up into the blind end of the colon. This retrograde movement of intestinal contents into blind ends of intestinal loops is so marked that we now always make an end-to-end union or a lateral union with the minimum amount of blind pouch. And few surgeons realize to what an astonishing degree dilatation of the ileum occurs after ileosigmoidostomy or any similar operation which does away with the ileocæcal valve.

A better knowledge of the course of the fistulous tract is obtained by study with the X-rays of the sinus which has been injected with some opaque mixture, whereupon the cure of intestinal fistulæ is often much accelerated.

The position of drainage tubes, or other opaque drainage material, may be easily and quickly verified by roentgen observation, especially when the operation concerns the diaphragm or some part above it. Often the entire train of unfavorable symptoms may be immediately changed, and impending defeat converted into success, by slight readjustment of drainage tubing under roentgen control. In subphrenic abscess, for example, not only may the diagnosis be confirmed at a much earlier date than by any other means, but the best method of approach-

ing the infection is easily determined with roentgen study. The patient need not be made to sit erect; it is entirely sufficient to study him lying in the supine and the left or right lateral position, as the indications may demand, without moving him from his bed. Here, especially, slight re-adjustment of drainage tubing under screen control, after the operation for drainage, has frequently re-established the flow of purulent material when the tube has become temporarily blocked in some manner.

Most important of all, however, is the employment of the roentgen rays in the early diagnosis of postoperative ileus. In *chronic* obstructions no one hesitates to introduce the requisite amount of opaque meal into the alimentary tract to permit the deliberate study of the passage of the opaque material; but in a *suspected acute* obstruction, one naturally hesitates to introduce more food into the alimentary tract. Nevertheless, early diagnosis is of paramount importance in acute obstruction, in order to minimize the profound general depression and high mortality attending late operation for ileus. It is not necessary to enumerate the various symptoms suggestive of ileus which in a fair percentage of abdominal cases become a cause of disquietude. In the great majority of instances these symptoms pass; but in a number there undoubtedly occurs a relative ileus which rights itself, often without being recognized.

In 1910 I began the employment of the bedside examination in cases of suspected ileus, including all cases of postoperative abdominal distention, even if only moderate: where nausea continued after the first 12 hours; and where the patient complained of intermittent abdominal pains, or other disturbing symptoms of whatever kind. We soon learned that this method permitted early determination of the existence or non-existence of obstruction, the degree of the hindrance, and perhaps the exact location and nature of the lesion. Furthermore, we were able to determine whether or not the obstruction was progressive. Continued experience with this means of diagnosis confirms our confidence in its value. We are thankful that postoperative ileus has in recent years become almost a rarity; nevertheless, it does surely occur occasionally in spite of all we can do. The technique I am about to describe will permit the recognition of these cases at an early stage, and save lives which would otherwise be lost.

The patient suspected of postoperative ileus need not be moved from his bed. The ordinary portable X-ray apparatus, which should nowadays be included in the equipment of every modern hospital, may be wheeled to the side of the bed, a large loaded plate-holder with intensifying screen slipped beneath the patient's back as he lies supine in the bed, and an anteroposterior exposure of the abdomen made in a few seconds while the patient holds his breath. The plate-holder and roentgen apparatus are then removed without further disturbance of the patient, the plate developed, and the findings made available within 15 or 20 minutes.

The developed roentgenogram will reveal at once whether there is any gas distention of the bowel, and, if so, whether the distention occurs in the small or in the large intestine. Enormous gas distention of the stomach is occasionally seen, and its absence immediately excludes postoperative gastric dilatation. Small and large intestine may be differentiated by the characteristic outlines of the gas areas. Recognition of the characteristic haustral markings of the colon will suggest the need of the colon tube and a small clysma to relieve the imprisoned gas. Equally characteristic is the appearance of the gas-distended coils in acute obstruction of the small bowel. The coils are more or less parallel and the caliber of the intestine is increased to 5, 6, 8, or even 10 centimeters in diameter. It is seen that the distention is not confined to a short segment of the intestine, but usually involves several meters. In the more serious type of cases the degree of distention is at once apparent and suggestive.

It should be remembered that the above observations are all made without any preparation of the patient whatsoever; it is usually not necessary to administer any opaque material at all. But, if the observation of the gas-filled bowel (without the ingestion of barium sulphate) does not give decisive information, time will be saved by proceeding at once to the administration of a small amount, say 15 to 20 grams, of barium sulphate in plain water, given in small, divided doses until the entire dose has been ingested. These cases are often so doubtful from the clinical standpoint that final decision as to operation is postponed in any case, and there is afforded ample time for some of the barium to pass on into the small intestine, in which case the intestinal picture is more characteristic. After a little experience, however, it is quite unnecessary to administer any barium at all by mouth, the decision being rendered on the appearance of the abdominal shadow with reference to the character and distribution of the gas areas which it may present.

This simple method of postoperative study is not more harmful to the patient than the manipulations necessary to the change of bed-linen, and I earnestly recommend its employment in all cases of suspected postoperative ileus.

In the above remarks I have tried to show how advantageously the roentgen rays may be called upon in a variety of conditions to assist the surgeon; but that the fullest value may be rendered in this service, close co-operation is required between surgeon and radiologist. In past years much of the time of the radiologist has been consumed in technical and laborious manipulations which may now be to a large extent carried out by technical assistants, and the time of the physician devoted to the more exclusively professional side of his work. It is also high time that the surgeon should familiarize himself with the field of radiological diagnosis and therapy. Only in this manner can successful co-operation be realized. "In union there is strength."

SOME COMMENTS ON THE SURGICAL TREATMENT OF HYPERTHYROIDISM

By JAMES T. CASE, M.D., F.A.C.S., Battle Creek, Michigan
Battle Creek Sanitarium

IN general, it may be stated that the ultimate treatment in every well-marked case of hyperthyroidism is surgery. Some of the leading Fellows of the American College of Surgeons feel that all other means of management are only temporal, and sooner or later the patient must submit to operation. This is a general statement, and naturally there are some exceptions. It is to these that I wish to draw your attention during the brief time at my disposal, as well as to the newer methods of rendering the operation more safe when it is finally decided upon.

It is not necessary here to review the signs of the disease, but only to emphasize the fact that persistent tachycardia, even though not marked, persistent nervousness, excitability and tremor not explained by some other form of clearly defined nervous disease, persistent though slight suffusion of the face, should always direct attention to the thyroid gland, especially if a latent goiter has existed for several years. Indeed, it is not unusual for a tumor of the thyroid to have existed for several years without the development of recognizable symptoms; then some sudden and unexpected event in the patient's life, death of a relative, strong emotional excitement of any kind, accident, mental shock, etc., sets to work the obscure process in the gland which results in the production and absorption of some toxin, the exact nature of which is not yet well recognized, although various theories have been advanced. It is a fact that the toxin is developed within the gland, and that many simple goiters may develop into toxic goiters.

Attention should also be called to the variations in the clinical picture in a given case. It is a fact that remissions often occur, and should such happen coincidently with the application of any therapeutic measure whatever, the physician will naturally feel that his treatment was the curative means. There are also many cases where the pathological picture resembles simple goiter, and it is often difficult to make an exact differentiation between this type and true exophthalmic goiter.

The present working theory is that the toxæmia is due to the absorption of toxic products from degenerating areas within the gland, and the therapeutic indication is, therefore, definite for removal of the source of the toxæmia, the glandular tissue. If the operation is done early, the results are satisfactory; but if surgical intervention is delayed, irreparable damage may occur to the cardiorenal system. Nevertheless, even in deferred cases, with far advanced complications, operation is indicated where possible for the removal of the source of the intoxication. In some of these cases the operation, though late, may result in a partial degree of cure.

Early diagnosis is obviously of the highest importance. I need not take your time to enumerate the usually recognized means of diagnosis of hyperthyroidism; but I will permit myself to refer briefly to the estimate of the basal metabolism by the respiratory calorimeter method, with which we are well acquainted in the Battle Creek Sanitarium, where I have the honor to be surgeon and director of the department of radiology. One of the members of our staff, Dr. Paul Roth, was associated with Dr. Benedict, of Boston, in the development of the metabolism apparatus in portable form for clinical use. No city should be without at least one clinic where the basal metabolism may be estimated, and the technique is not so difficult that the work cannot be accurately done in any clinic. Neither is the expense so great as to prohibit the purchase and upkeep of the necessary equipment. In our institution, the basal metabolism is estimated as a matter of routine in all nervous patients, so-called neurasthenics, and the result of the test of metabolism is a great aid in differentiating hyperthyroidism from the various other diseases characterized by tachycardia. Especial interest is attached to the value of this method in distinguishing early tuberculosis from early hyperthyroidism.

It is important to make a thorough examination of the nose and throat for possible local foci of infection. In no small proportion of cases of mild hyperthyroidism, with beginning changes in the heart rhythm, removal of the tonsils or infected teeth, or adequate clearing up of sinus infection, cause a prompt drop in the metabolic rate and disappearance of the cardiac symptoms. Even in cases of well-marked organic disease, where a co-existing sinus, tooth or tonsil infection is detected, it is important to attend to these foci of infection before proceeding to radical operation on the thyroid gland; for the patient will thus have become much better able to withstand the thyroid operation.

Hot water injections have been extensively employed in various countries; but on the whole this treatment is attended by considerable danger and the results are not dependable.

Ligation of one or both of the superior thyroid arteries gives immediate results in most cases; but after a few months of remission, the hyperthyroidism gradually returns.

Radiotherapy has been employed for nearly 20 years in the treatment of hyperthyroidism, encouragement for this method emanating chiefly from internists who were seeking to find some non-

surgical method of cure. Undoubtedly many cases of definite hyperthyroidism, both of the hyperplastic and the non-hyperplastic types, have been favorably influenced by properly administered radiotherapy, and every radiologist of experience can relate several cases where the cure has been complete and permanent. Nevertheless, much opposition has been raised to this means of managing hyperthyroidism, some claiming that the beneficial effects of radiation were only temporary, the symptoms recurring within 3 or 4 months; others maintaining that actual damage is done the patient, making subsequent operation much more difficult if radiation fails.

My personal practice is the following: Radiation (meaning treatment either with the roentgen rays or with radium) is permitted for all cases of mild hyperthyroidism, where one hesitates to recommend surgical procedure (cases where the metabolic rate is between 15 and 25 or 30 plus); also when the metabolic rate is above 50, the irradiation being administered in the latter instance to depress thyroid activity definitely until a metabolic rate of 40 or lower, if possible, is obtained. The patient may then be operated upon with the greatest safety.

There is not a doubt that some of the patients thus treated return later with a reappearance of the symptoms; but even in these the irradiation has had an effect equal to ligation of one or both of the superior thyroid arteries. It is our custom to prefer one preliminary ray treatment as equal in value to the ligation of one artery. If it is the intention to manage the case entirely without surgery, then the ray treatment is repeated at monthly intervals until three or four series of treatments have been applied.

In most cases the symptoms abate immediately after the application of the first dose, so that at the time of the second application, one month later, there is a conspicuous improvement in the outstanding symptoms. The basal metabolic rate also diminishes, though not in proportion to the clinical improvement of the patient.

Again permit me to remark that at a later operation on one of these irradiated cases it is rare that any difficulty is found which can honestly be charged to the irradiation treatment. In my operative work on such patients I have sometimes encountered excessive bleeding due to numerous adhesions, but no more marked than I frequently note in goiter cases that have not been submitted to previous treatment of any kind whatever. I feel therefore that the objections to radiation therapy, even in cases which will probably have to come to operation later, are not as serious as some would have us believe. And, further, there is no doubt that many cases of hyperthyroidism may be brought to a happy conclusion without the necessity of operation. Many patients treated 6 to 12 years ago for hyperthyroidism have not had a recurrence.

Nevertheless it must also be admitted that surgical extirpation, under all the favorable conditions set forth by Crile and his associates, guided by the accurate metabolism measurements, offers the most dependable and immediately successful therapeutic measure in this disease, which, if neglected, is followed by such dire results.

CLINICAL CONGRESS OF AMERICAN COLLEGE OF SURGEONS

THIRTEENTH ANNUAL SESSION, CHICAGO, OCTOBER 22–26, 1923

HARVEY CUSHING, Boston, *President* — ALBERT J. OCHSNER, Chicago, *President-Elect*
FRANKLIN H. MARTIN, Chicago, *Director-General*

LOCAL EXECUTIVE COMMITTEE

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PLANS FOR THE CLINICAL MEETING IN CHICAGO

WEEK'S PROGRAM IN BRIEF

Monday, October 22

9–12. Hospital Conference, Gold Room, Congress Hotel. Papers and discussions.
2–5. Hospital Conference, Gold Room, Congress Hotel. Round table conference.
8. Presidential Meeting, Orchestra Hall. Inaugural address of President-Elect and Murphy Oration on Surgery.

Tuesday, October 23

9–12. Clinics and demonstrations at the hospitals and medical schools.
2–4. Clinics and demonstrations at the hospitals and medical schools.
4. Laying of cornerstone of Murphy Memorial.
8. Scientific session, Gold Room, Congress Hotel. Papers and discussions.

Wednesday, October 24

9–12. Clinics and demonstrations at the hospitals and medical schools.
2–5. Clinics and demonstrations at the hospitals and medical schools.
8. Scientific session, Gold Room, Congress Hotel. Papers and discussions.

Thursday, October 25

9–12. Clinics and demonstrations at the hospitals and medical schools.
2–4. Clinics and demonstrations at the hospitals and medical schools.
4. Annual meeting of the Fellows of the American College of Surgeons, Gold Room, Congress Hotel.
8. Scientific session, Gold Room, Congress Hotel. Papers and discussions.

Friday, October 26

9–12. Clinics and demonstrations at the hospitals and medical schools.
2–5. Clinics and demonstrations at the hospitals and medical schools.
8. Eleventh Convocation of the American College of Surgeons, Auditorium Theater.

IN the following pages will be found a preliminary program of clinics and demonstrations to be given at the thirteenth annual session of the Clinical Congress in Chicago, beginning Tuesday, October 23, and ending on Friday, October 26. This program is to be completely revised and amplified previous to the meeting to include all of the important medical institutions and clinicians of the city so that the final program will completely present the clinical activities of this great medical center. All departments of surgery will be represented therein: General surgery, gynecology, obstetrics, orthopedics, urology, surgery of the eye, ear, nose, throat, and mouth, experimental surgery, surgical pathology, roentgenology, etc. Clinical demonstrations or "dry clinics," in which the internists, pathologists, and others connected with the various institutions will participate, will provide interesting features of the program. The real program of the Congress, however, will be issued daily during the meeting and will be complete in detail as to the cases to be

operated upon and the demonstrations to be given.

The morning and afternoon hours of Monday are set apart for a conference on the hospital standardization program of the College and the problems related thereto. The program for the conference is in preparation and will consist of papers and discussions by surgeons, hospital superintendents, nurses, trustees, and others interested in the conduct of hospitals.

Dr. Albert J. Ochsner, president-elect, will be inaugurated and deliver the annual address at the presidential meeting to be held in Orchestra Hall on Monday evening. The distinguished visitors from foreign countries will be introduced at this meeting.

On Tuesday, Wednesday, and Thursday evenings in the Gold Room of the Congress Hotel will be held a series of scientific meetings, the programs for which are being prepared by the executive committee of the Congress. Papers dealing with surgical subjects of timely interest will be read and discussed by eminent surgeons of the United States and Canada and distinguished visitors from Europe and South America.

On Friday evening in the Auditorium, at the eleventh convocation of the American College of Surgeons, fellowship in the College will be conferred upon a group of American and Canadian surgeons and honorary fellowship upon the distinguished foreign guests.

General headquarters for the Congress will be established at the Congress Hotel where the Ballroom, Florentine, Elizabethan, and St. Francis rooms, together with the foyers and other rooms adjacent thereto on the first and second floors, have been reserved for the exclusive use of the Congress. These rooms will be utilized for evening meetings, registration and ticket bureaus, bulletin rooms, etc.

An application for reduced railway rates on account of this meeting is pending with the railway passenger associations and it seems assured that a substantial reduction in fares will be granted, applying to all portions of the United States and Canada.

LIMITED ATTENDANCE—ADVANCE REGISTRATION

Because of the popularity of these annual clinical meetings it has been found necessary in recent years to adopt the plan of limiting attendance. This plan necessitates registration in advance on the part of all who wish to attend. The limit of attendance is based upon the result of a survey of the amphitheaters, lecture rooms, and laboratories in the several hospitals and medical schools as to their capacity for accommodating visitors. When the limit of attendance has been reached through advance registration no further applications will be accepted, hence the necessity for early registration. It is to be expected that the limit of attendance will be reached some weeks in advance of the meeting.

CLINIC TICKETS

Attendance at all clinics and demonstrations is controlled by means of special clinic tickets, which are issued at headquarters each morning at 8 o'clock for that day's clinics. The use of clinic tickets has proven an efficient means of providing for the distribution of the visiting surgeons among the several clinics and insuring against overcrowding, as the number of tickets issued for any clinic is limited to the capacity of the room in which that clinic is to be given.

A complete detailed schedule of the day's clinics will be posted on bulletin boards at headquarters during the afternoon of the preceding day. After the program has been so posted, reservations for tickets for the next day's clinics may be filed, the tickets to be issued the following morning at 8 o'clock. A printed program will be issued each morning which will contain the complete clinical program for the day, with announcements of evening sessions and other information.

REGISTRATION FEE

In order that no financial burden may be imposed upon the members of the profession in the city entertaining the Congress, a registration fee of $5.00 is required of each surgeon attending the clinical meeting, such fee providing the funds with which to meet the expenses of conducting the meeting. A formal receipt for the registration fee is issued to each surgeon registering in advance which receipt is to be exchanged for a general admission card upon his registration at headquarters. This card, which is non-transferable, must be presented to secure clinic tickets and for admission to the evening meetings.

PRELIMINARY CLINICAL PROGRAM

COOK COUNTY HOSPITAL

Operative clinics, daily, morning and afternoon. Pathological conference, daily, 11. Clinical demonstrations will be given as follows:

F. A. Besley—Sarcoma of the extremities, with exhibit of cases.
W. R. Cubbins—Indications for enterostomy in intestinal obstruction.
Vernon David—Osteomyelitis in children; also local recurrence in carcinoma of the rectum.
George Davenport—Demonstraton: Ventriculography in brain lesions.
G. G. Davis—Injuries of the spine and spinal cord.
F. G. Dyas—Carcinoma of the stomach.
D. N. Eisendrath—Cases illustrating surgery of the kidney and ureter.
Harry Jackson—Rôle of intracranial pressure in injuries of the brain and skull.
E. J. Lewis—Early management of compound fractures.
Hugh McKenna—Cases of fracture of the neck of the femur.
R. W. McNealy—Aneurism of the aorta and peripheral vessels.
Karl Meyer—Acute perforating ulcers of the stomach.
Paul Oliver—Carcinoma of the breast.
K. Speed—Standardization of fracture treatment; arthroplasty.
D. C. Straus—Diagnosis and treatment of cholecystitis and cholelithiasis.
George Thompson—Common duct stones.
R. T. Vaughan—Lung abscess.

MERCY HOSPITAL

Tuesday, October 23

J. F. Golden, C. F. Sawyer, and E. L. Moorhead—9. General surgery.
G. W. Mahoney—9. Eye clinic.
E. L. Moorhead—2. General surgery.
H. Dooley—2. Genito-urinary clinic.

Wednesday, October 24

Philip H. Kreuscher—9. Bone and joint cases.
E. L. Moorhead and F. E. Pierce—9. General surgical operations.
Henry Schmitz—9. Gynecological clinic.
R. J. Tivnen—9. Eye, ear, nose, and throat clinic.
John D. Claridge—2. Bone and joint cases.
C. Larkin—2. General surgery.

Thursday, October 25

E. L. Moorhead and C. F. Sawyer—9. General surgical operations.
Philip H. Kreuscher—9. Bone and joint cases.
R. J. Tivnen—Eye, ear, nose, and throat clinic.
H. Dooley—2. Genito-urinary clinic.

Friday, October 26

Philip H. Kreuscher—9. Special arthroplasty clinic.
Henry Schmitz—9. Gynecological clinic.
John F. Golden—9. General surgery.

Daily

Staff—9–5. Out-patient clinics.
Staff—X-ray demonstrations.

WESLEY MEMORIAL HOSPITAL

Tuesday, October 23

Mark T. Goldstine—9. Vaginal plastics.
Staff—2. Dry clinic: J. Gordon Wilson—Differentiation between labyrinthine and cerebellar disease. Otis H. Maclay—Ethmoid infections. C. B. Younger—Sinus infections. C. F. Bookwalter—The intranasal operation on the tear sac.

Wednesday, October 24

Allen B. Kanavel—9. Brain tumor. Plastics on the hands and face. Goiter.
John A. Wolfer—2. Gastric surgery.

Thursday, October 25

William E. Schroeder—9. Breast tumors. Kidney surgery.
Paul B. Magnuson—2. Bone grafts in the spine. Operations on old fractures of the os calcis. Injuries about the shoulder, elbow, and wrist joint.

Friday, October 26

H. M. Richter—9. Gall-bladder diseases. Goiter and stomach cases.
V. D. Lespinasse—2. Sterility cases.
Charles B. Reed—3:30. Measurements of the fetus in utero. Induction of labor and bag work.

AUGUSTANA HOSPITAL

Tuesday, October 23

N. M. Percy—9. General surgery.
Dennis W. Crile—2. Fracture clinic.

Wednesday, October 24

A. J. Ochsner—9. General surgery.
E. H. Ochsner—9. General surgery.
Rudolph Oden—2. General surgery.
Rudolph Holmes—3:30. Obstetrical clinic.

Thursday, October 25

N. M. Percy—9. General surgery.
John Nuzum—2. General surgery.

Friday, October 26

A. J. Ochsner—9. General surgery.
E. H. Ochsner—9. General surgery.
Alfred Murray—2. Sinus clinic.

ST. LUKE'S HOSPITAL

A. E. Halstead, L. L. McArthur, and W. M. Harsha—General surgery.
J. L. Porter and E. W. Ryerson—Orthopedic clinic.
T. J. Watkins and A. H. Curtis—Gynecological clinic.
R. B. Preble, J. A. Capps, and A. R. Elliott—Medico-surgical cases.

LYING-IN HOSPITAL

J. B. DeLee, D. S. Hillis, D. F. Monash, E. L. Cornell, D. A. Horner, and Anna R. Lapham—Daily, 2. Obstetrical clinic.

CHILDREN'S MEMORIAL HOSPITAL

Tuesday, October 23

ALBERT H. MONTGOMERY—2. General surgery.
THOMAS GALLOWAY—2. Nose and throat clinic.

Wednesday, October 24

M. HANCHETT—9. General surgical operations.
WALTER C. BURKET—2. General surgery.
EDWIN W. RYERSON and ROBERT O. RITTER—3. Orthopedic operations.

Thursday, October 25

THOMAS GALLOWAY—10:30. Nose and throat operations.
EDWIN MILLER and ERNEST MCGILL—2. General surgery.
JOHN C. WILLIAMS—2. Nose and throat clinic.

Friday, October 26

ALBERT H. MONTGOMERY—9. General surgical operations.
M. HANCHETT—2. General surgery.
EDSON FOWLER—3. Orthopedic clinic.

MICHAEL REESE HOSPITAL

D. N. EISENDRATH—Kidney and bladder operations with demonstration of cases.
L. A. GREENSFELDER—Thyroid clinic, operations and demonstration of cases.
EMANUEL FRIEND—Gall bladder operations with demonstration of cases.
D. C. STRAUSS—Fracture and osteomyelitis cases, operations and demonstration of (a) recent advances in the treatment of fractures and osteomyelitis with special reference to children; (b) advances in the diagnosis of gall-bladder disease and its surgical treatment.
GEORGE L. DAVENPORT—Ventriculography; brain tumor operations; demonstration of cases with technique of ventriculography.
ALFRED A. STRAUSS—Operations on the stomach with demonstration of stomach and intestinal cases.
RALPH BETTMAN—Thoracic surgery with demonstration of cases.
HARRY JACKSON—Operations and demonstration of management of acute cranial injuries.
EDMUND ANDREWS—Hernia clinic, operations and demonstration of cases.
CHARLES JACOBS—Orthopedic clinic, operations and demonstration of cases.
M. A. BERNSTEIN—Orthopedic clinic, operations and demonstration of cases.
JAMES PATEJDL—Orthopedic clinic, operations and demonstration of cases.
ROBERT A. ARENS—Demonstrations in X-ray department: (a) Recent advances in the new high-voltage treatment of surgical cases with special reference to precise methods of measuring X-ray quantity; (b) cases of sarcoma treated by the higher voltage; (c) exhibit of plates showing surgical lesions.
L. E. FRANKENTHAL—Operations for incontinence and complete laceration, with demonstration of cases.
L. SIMON—Obstetrical operations, with demonstration of cases.
JOSEPH L. BAER—Adnexal disease, toxæmias of pregnancy, capillaroscopy, obstetrical operations.
IRVING STEIN—Uterine tumors; pneumoperitoneum, transuterine and transabdominal.
WILLIAM RUBOVITZ—Operations for prolapse, obstetrical operations.
JULIUS LACKNER—Vesico-vaginal and recto-vaginal fistulas; obstetrical operations.
L. E. SCHMIDT, G. KOLISCHER, I. S. KOLL, J. S. EISENSTAEDT, and H. KATZ—Genito-urinary clinic, operations and demonstration of cases.
M. L. GOODKIND—Medico-surgical cases.
J. C. FRIEDMAN—Gastroduodenal ulcer, symptomatology and diagnosis.
S. STROUSE—Use of Insulin in preparation of diabetics for operation.
D. SCHRAM—Heart pathology in chronic intoxications, particularly diabetes.
J. MEYER—Splenomegalic hæmolytic jaundice, surgical significance.
I. PILOT—Lung abscess and gangrene following general anæsthesia.
WILLIAM A. BRAMS—Unusual forms of gastric ulceration.
W. W. HAMBURGER—Rate of electrocardiography in surgical diagnosis and prognosis.
HARRY KAHN—Tuesday and Thursday, 9. Ultra-violet rays in diseases of the nose and throat.
ROBERT SONNENSCHEIN—Thursday and Friday, 9. Nose and throat clinic.
JEROME STRAUSS—Wednesday, 2. Nose and throat clinic.
IRA FRANK—Thursday, 2. Nose and throat clinic.

NELSON MORRIS INSTITUTE FOR RESEARCH

O. T. SCHULTZ—Pathological demonstrations.
B. PORTIS—Protective mechanisms of the omentum.
W. BLOOM—Experimental studies in obstructive jaundice.
W. H. ROSENAU—Clinical and experimental studies on liver function.

CHICAGO MEMORIAL HOSPITAL

Tuesday, October 23

DAVID S. HILLIS and J. E. FITZGERALD—9. Obstetrical clinic.
JULIA C. STRAWN and A. E. KANTER—10. Gynecological clinic.
STAFF—2. Eye, ear, nose, and throat clinic

Wednesday, October 24

H. R. CHISLETT, CHARLES E. KAHLKE, PETER S. CLARK, R. A. MELENDY, P. M. OLIVER, and W. M. HANCHETT—9. General surgical clinic.
D. N. EISENDRATH, J. M. MALTMAN, and D. G. BRUNJES—11. Genito-urinary clinic.

Thursday, October 25

DENNIS W. CRILE—9. Orthopedic clinic.
JULIA C. STRAWN, A. E. KANTER, DAVID S. HILLIS, and J. E. FITZGERALD—11. Gynecological and obstetrical clinic.
STAFF—2. Eye, ear, nose, and throat clinic.

Friday, October 26

STAFF—9. Presentation of borderline cases from all departments.

NORTH CHICAGO HOSPITAL

CARL BECK, EMIL G. BECK, J. FREDERICK HARVEY—General surgery.
JOSEPH C. BECK, HARRY L. POLLOCK, FRANCIS L. LEDERER—Eye, ear, nose, and throat operations, and demonstration of cases.
BENJAMIN H. ORNDOFF and staff—Diagnosis of surgical and medical cases with special reference to the use of the X-ray and pneumoperitoneum.

ST. JOSEPH'S HOSPITAL

Tuesday, October 23

HUGH MCKENNA—9. Inguinal hernia, appendectomy, gall bladder, bone transplant for non-union, demonstration of author's fracture table.

A. A. HAYDEN—9. Stacke operation for chronic purulent mastoiditis; suture of pillars for control of hæmorrhage in tonsillectomy; demonstration of head bandages; correction of external nasal deformities.

CHARLES MCKENNA—10. Vasotomy, inguinal hernia, prostatectomy.

TRUMAN BROPHY—10. Cleft palate and hair-lip cases.

Wednesday, October 24

THOMAS O'DONOHUE—9. Demonstration: Cases of resection of sigmoid for malignancy with X-ray pictures before and after operation; cases of multiple diverticulitis of large bowel.

FRANK DAVID—9. Hæmorrhoids, fistula of rectum.

OSCAR OFNER—10. Conservative or radical treatment of inflammatory adnexa of the uterus.

W. GROSVENOR, FRED ROHR, and L. W. MARTIN—Demonstration of obstetrical technique with manikin.

DAVID FITZGERALD—10. Abdominal and gynecological operations.

W. H. G. LOGAN—10. Cleft palate and hair-lip cases.

Thursday, October 25

HUGH MCKENNA and CLEMENT DE BERR—9. End-results in fracture cases and blood transfusion in chronic bone infection cases.

FRANK B. MCCARTHY—10. Abdominal operations.

J. HOLINGER—10. Bexold mastoid operation.

J. Z. BERGERON—9. Canfield antrum operation, frontal sinus operation, tonsillectomies.

A. A. HAYDEN—2. Stacke operation for chronic purulent mastoiditis; suture of pillars for control of hæmorrhage in tonsillectomy; demonstration of head bandages; correction of external nasal deformities.

Friday, October 26

A. A. HAYDEN—9. Stacke operation for chronic purulent mastoiditis; suture of pillars for control of hæmorrhage in tonsillectomy; demonstration of head bandages; correction of external nasal deformities.

SPECIAL DEMONSTRATIONS

L. E. HINES—The pathology in a case of heart disease associated with pregnancy.

WILLIAM H. BURMEISTER, LELAND SHAFER, and F. O. FREDERICKSON—Medico-surgical cases with fluoroscopy of the chest and following bismuth meals.

E. L. JENKINSON—Daily, 3. X-ray therapy.

LOYOLA UNIVERSITY MEDICAL SCHOOL

Tuesday, October 23

LLOYD ARNOLD—2. Special demonstration in pathology and bacteriology.

Wednesday, October 24

M. T. STRONG and T. T. JOBE—2. Special demonstration in anatomy.

Thursday, October 25

S. A. MATTHEWS—2. Special demonstration in physiology.

Friday, October 26

W. C. AUSTIN—2. Special demonstration in chemistry.

COLUMBUS HOSPITAL

Tuesday, October 23

J. R. PENNINGTON—9. Rectal diseases

M. M. RITTER—11. Eye, ear, nose, and throat clinic.

W. H. O. HOFFMAN—2. Pediatric clinic.

S. R. PIETROWICZ—3. Medico-surgical cases.

J. DAMIANI—4. Roentgenological diagnosis.

Wednesay, October 24

DANIEL A. ORTH, W. B. GERHARD, T. A. CARTER, WILLIAM SADLER, M. J. SEIFERT, and L. C. QUINN—9. General surgical clinic.

J. E. H. ATKEISSON—2. Anæsthesia.

W. H. GEHL—3. Genito-urinary surgery.

C. W. BARRETT—4. Gynecological clinic.

Thursday, October 25

FREDERICK MUELLER—9. Orthopedic clinic.

LENA SADLER—11. Gynecological and obstetrical clinic.

O. W. MCMICHAEL—2. Medico-surgical cases.

HAROLD MOYER—3. Neuro-surgical cases.

C. O. GETTY—4. Laboratory demonstrations.

Friday, October 26

DANIEL A. ORTH, W. B. GERHARD, T. A. CARTER, WILLIAM SADLER, M. J. SEIFERT, and L. C. QUINN—9. General surgical clinic.

C. O. LINDSTROM—2. Eye, ear, nose, and throat clinic.

JOSEPH WELFELD—3. Dermatology.

L. P. KUHN—4. Industrial surgery.

Daily at 8:30

Emergency drill by surgical nurses.

WOMEN'S AND CHILDREN'S HOSPITAL

Tuesday, October 23

MARY G. MCEWEN and ANNA BLOUNT—9. General surgery.

MARGUERITE JONES and NORA RAGER—9. Nose and throat clinic.

BERTHA SHAFER—2. Syphilis clinic.

EFFA V. DAVIS, RHODA P. BARSTOW, and JOHANNA HEUMANN—3. Pediatric clinic.

Wednesday, October 24

LENA K. SADLER and JULIA STRAWN—9. General surgery.

LILLIAN E. TAYLOR and GERTRUDE THOMPSON—9. Nose and throat clinic.

SARAH M. HOBSON, CLARA FERGUSON, ARMINA HILL, MARIE ORTMAYER, and ELIZA MORSE—2. Medico-surgical clinic.

Thursday, October 25

ALICE CONKLIN—9. General surgery.

KATHERINE B. RICH and ROSE Z. BENNET—9. Nose and throat clinic.

STAFF—2. Cancer clinic: MAUD SLYE—Heredity of cancer. HELEN B. FLYNN—Infection of cancer and serum treatment. MARY E. HANKS—X-ray treatment of cancer. WALBURGA KACIN—Emetin treat ment in cancer. Radium treatment

Friday, October 26

BERTHA E. BUSH and MARY J. KEARSLEY—9. General surgery.

JANE F. BEEM and H. STEPHENS WALKER—9. Nose and throat surgery.

RACHEL S. YARROW, PEARL M. STETLER, VESPER R. SHAFFER, LOUISE ACRES, HELGA RUUD—2. Obstetrical clinic. Demonstration of twilight sleep.

UNIVERSITY HOSPITAL

Tuesday, October 23

E. V. L. Brown—9. Eye clinic.
C. C. Rogers—10. General surgery.

Wednesday, October 24

Harry Culver—9. Urological clinic.
Charles Davison—10. General surgery, cases of undescended testicle.
Charles Davison—2. General surgery.

Thursday, October 25

J. P. Sprague—9. Orthopedic surgery.
Karl A. Meyer—10. General surgery, gastro-intestinal cases.

Friday, October 26

William E. Gamble—9. Eye clinic.
C. S. Bacon—10. Obstetrical clinic.

ST. MARY'S HOSPITAL

Tuesday, October 23

D. A. Orth and George Mueller—9. General surgery.
H. Schmitz, H. Bundy, and J. Laibe—9. Radium clinic.
F. B. Lusk—2. Laboratory demonstrations.
C. Challenger—2. X-ray demonstrations.

Wednesday, October 24

N. M. Percy, O. E. Nadeau, W. A. Kewflewski, and T. Z. Xelowski—9. General surgery.
J. J. Killeen—2. Ear, nose, and throat clinic.
G. W. Mahoney—2. Eye clinic.

Thursday, October 25

A. J. Ochsner, D. A. Orth, George Mueller, and O. E. Nadeau—9. General surgery.
S. R. Pietrowicz—9. Medico-surgical cases.
D. W. Crile—2. Orthopedic clinic.

Friday, October 26

R. E. Flannery, E. Patera, M. J. Seifert, and C. Stotz—9. General surgery.
E. K. Batholomew—9. Medico-surgical cases.
J. Welfeld—2. Genito-urinary and skin clinic.

RAVENSWOOD HOSPITAL

Tuesday, October 23

Darwin Pond—9. General surgery. Fracture cases.

Wednesday, October 24

Clark A. Buswell—9. General surgery. Laparotomies, tonsillectomies.

Thursday, October 25

G. W. Green and G. N. Bussey—9. General surgery. Goiter cases and laparotomies.

MT. SINAI HOSPITAL

H. M. Richter—Surgery of the thyroid and the bile tracts.
V. L. Schrager—Abdominal surgery, hernia cases.

ST. ANNE'S HOSPITAL

B. W. Mack, George W. Post, Jr., H. J. Dooley and associates—Daily, 9. General surgery.

EYE AND EAR INFIRMARY

Tuesday, October 23

M. Goldenburg and R. von der Heydt—2. Eye clinic.
H. R. Boettcher—2. Ear, nose, and throat clinic.

Wednesday, October 24

D. C. Orcutt—2. Eye clinic.
N. H. Pierce—2. Ear, nose, and throat clinic.

Thursday, October 25

E. K. Findlay—2. Eye clinic.
U. J. Grim—2. Ear, nose, and throat clinic.

Friday, October 26

H. W. Woodruff—2. Eye clinic.
S. M. Hager—2. Ear, nose, and throat clinic.

ST. ANTHONY'S HOSPITAL

Tuesday, October 23

Lawrence Ryan—9. Plastic surgery, operative clinic.
F. J. E. Ehrmann, Joseph Zabokrtsky, and S. E. Donlon—2. General surgical clinic.

Wednesday, October 24

F. J. E. Ehrmann, Joseph Zabokrtsky, and S. E. Donlon—9. General surgical operations.
Lawrence Ryan—2. Dry clinic, plastic surgery.
Evelyn Ehrmann and F. B. Olentine—2. Laboratory demonstrations.

Thursday, October 25

Lawrence Ryan, R. C. Cupler, Joseph Zabokrtsky, and F. B. Olentine—9. General surgical operations.
Otto Jirsa—2. Demonstration of genito-urinary cases.
L. S. Tichy—2. X-ray demonstration.

Friday, October 26

J. E. Stanton, F. J. Fara, Robert Hardie, and J. C. Stubbs—9. Staff meeting with presentation of cases.
John Theobald and H. M. Thometz—2. Nose and throat clinic.
Max Weisskopf—2. Obstetrical clinic.

LUTHERAN DEACONESS HOSPITAL

Tuesday, October 23

E. E. Henderson and G. H. Schroeder—9. General surgery, diagnostic and operative clinic.

Wednesday, October 24

S. Dahl—9. General surgery.
I. Pilot—9. The habitat and distribution of hæmolytic streptococci and their rôle in surgical infections.

Thursday, October 25

A. E. Kanter—9. Gynecological clinic.

Friday, October 26

E. E. Henderson and G. H. Schroeder—9. General surgery, diagnostic and operative clinic.
R. Householder—9. X-ray diagnosis of surgical conditions.

FRANCES WILLARD HOSPITAL

Tuesday, October 23

FRENCH CARY—2. Genito-urinary clinic.

Wednesday, October 24

FRANK D. MOORE—2. General surgery.

Thursday, October 25

VICTOR L. SCHRAGER—2. General surgery.

PRESBYTERIAN HOSPITAL

A. D. BEVAN, DEAN LEWIS, CARL B. DAVIS, D. B. PHEMISTER, GATEWOOD, V. C. DAVID, H. L. KRETSCHMER, R. H. HERBST, G. L. MCWHORTER, EDWARD MILLER, A. H. MONTGOMERY, F. B. MOOREHEAD, C. A. PARKER—General surgery, urology, orthopedics.

N. S. HEANEY, CAREY CULBERTSON, W. F. HEWITT—Gynecological clinics.

W. H. WILDER and assistants—Eye clinics.

G. E. SHAMBAUGH and assistants—Nose and throat clinics

CHICAGO HOTELS AND THEIR RATES

While the hotels of Chicago have a large capacity for the entertainment of visitors, it is well for those expecting to attend the Congress to make reservation of hotel accommodations at the earliest possible date. The following hotels are recommended by the local committee:

	Minimum Rate Single Room	
	With Bath	Without Bath
Atlantic	$3.50	$2.00
Auditorium	5.00	2.50
Blackstone	5.00	4.00
Brevoort	3.00	2.00
Chicago Beach	4.00	3.00
Congress	4.00	3.00
Cooper-Carlton	3.50	....
Drake	5.00	....
Edgewater Beach	$3.00	$....
Fort Dearborn	2.45	1.95
Great Northern	3.50	2.50
LaSalle	4.00	2.50
Lexington	3.00	2.00
Morrison	4.00	....
Planters	3.00	2.00
Sherman	3.00	2.00

STATE AND PROVINCIAL SECTIONAL MEETINGS OF THE CLINICAL CONGRESS OF AMERICAN COLLEGE OF SURGEONS

THE Sectional Meetings of the American College of Surgeons for the coming autumn season will be conducted as follows:

MANITOBA

The Sectional Meeting for the province of Manitoba is to be held this year in Winnipeg on September 10 and 11. The various sessions will cover a period of two days and will include a Hospital Standardization Meeting on the afternoon of the first day, and a Community Health Meeting in the evening, to which everyone is invited.

Dr. Daniel S. MacKay, of Winnipeg, is Chairman of the Provincial Committee, Dr. Gordon S. Fahrni, of Winnipeg, is Secretary, and Dr. Jasper Halpenny, of Winnipeg, is Counsellor.

The committee is putting forth every effort to see that this year's Sectional Meeting is the best which the College has ever had in Manitoba. Clinics are to be conducted at the local hospitals and a Scientific Session on the second afternoon.

ALBERTA AND SASKATCHEWAN

The Sectional Meeting for these two provinces is to be held in Edmonton on the 14th and 15th of September next. The headquarters and registration will be at the MacDonald Hotel where the Hospital Standardization and Scientific Meetings will also be conducted. The Public or Community Health Meeting on the night of the 14th, will be a very attractive one. Clinics are to be conducted at the local hospitals.

The Committee on Arrangements is sparing no effort in making this coming meeting very profitable to everyone who attends.

The Provincial Committee is composed of Dr. F. W. Gershaw, of Medicine Hat, Chairman, and Dr. A. R. Munroe, of Edmonton, Secretary.

MONTANA AND NORTH DAKOTA

The Montana and North Dakota Sectional Meeting of the American College of Surgeons will be held in Great Falls on September 18 and 19. Announcement of this meeting and place of registration will shortly be sent to all the Fellows of the College in these two states.

The Public Meeting will be held on the night of the 18th.

The State Committee of Montana is composed of Dr. Fred F. Attix, of Lewistown, Chairman; Dr. James H. Irwin, of Great Falls, Secretary; and Dr. Rudolph Horsky, of Helena, Counsellor. This committee will spare no effort to make the Sectional Meeting in Montana one of the very best.

OREGON AND IDAHO

The Sectional Meeting for the states of Oregon and Idaho will be held in Portland on the 24th and 25th of September. Elaborate arrangements are being carried out to make this one of the largest meetings which the College has ever had. Fellows of the College from the states of California and Nevada have also been invited.

The Public Meeting will be held on the night of the 24th and an excellent program is being provided.

The State Committee for Oregon is composed of Dr. E. F. Tucker, of Portland, Chairman; Dr. J. A. Pettit, of Portland, Secretary; and Dr. William B. Holden, of Portland, Counsellor.

Dr. E. A. Sommer, of Portland, is actively engaged in assisting this committee in its arrangements for the Sectional Meeting.

BRITISH COLUMBIA AND WASHINGTON

The Sectional Meeting for the province of British Columbia and the state of Washington will be held in Victoria, B. C., on September 28 and 29. Headquarters will be at the Empress Hotel.

The Public Meeting will be held on the night of the 28th and will be of interest to both laymen and doctors. An excellent group of speakers is engaged for this meeting. Clinics will be conducted in the local hospitals and the Hospital Standardization Meeting will be held at the Empress Hotel on the first day. The Scientific Meeting will be held on the afternoon of the second day.

Local arrangements are in charge of a committee with Dr. H. M. Robertson as Chairman, and Dr. D. W. Graham, as Secretary.

The Provincial Committee for British Columbia is composed of Dr. W. B. Burnett, of Vancouver, Chairman; Dr. A. B. Schinbein, of Vancouver, Secretary; and Dr. J. J. Mason, of Vancouver, Counsellor.

COLORADO, UTAH, WYOMING, AND ARIZONA

The Sectional Meeting for these states will be held in Denver, October 4 and 5. Headquarters and registration will be at the Brown Palace Hotel. Arrangements are in charge of a local committee with Dr. Oliver Lyons as Chairman. The Fellows of the College have all joined together to make this a most successful meeting.

It is expected that the Community Health Meeting will be very largely attended and an excellent program is being prepared. The Hospital and Scientific Meetings will be held at the Brown Palace Hotel. Clinics will be conducted at the local hospitals.

These meetings, it is noted, are practically all in the Northwest and will complete the Group Meetings for the year ending with the Clinical Congress, to be held in Chicago in October, 1923.

In the month of November, Sectional Meetings will be held for the states of Michigan, Ohio, Illinois, Indiana, Wisconsin, and the provinces of Ontario and Quebec.

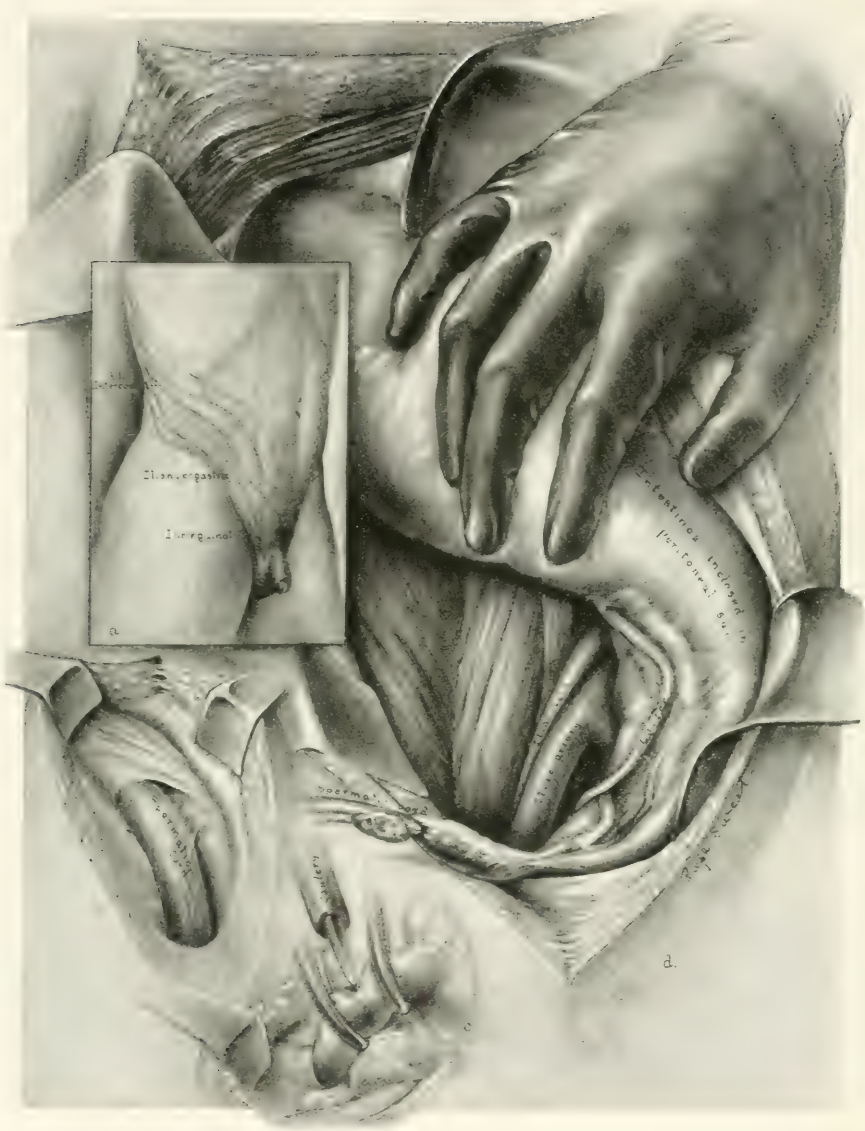

Fig. 5. Drawing in illustration of the technical steps of radical resection of the primary lymph zone. *a*, Shows two types of incision. The one following the outer edge of the rectus for some distance and then curving out along the lower side of the twelfth rib gives a better exposure. *b*, Shows the initial inguinal incision exposing the cord which is clamped before delivering the tumor mass from the scrotum. *c*, Cautery division of the cord after gross inspection has confirmed the diagnosis. *d*, Shows the method of stripping back of the peritoneum beginning in the iliac fossa. The ureter and spermatic vessels strip up with the peritoneum. The vas deferens is seen crossing the ureter and is divided low down behind the bladder.

The Radical Operation for Teratoma Testis. —*Frank Hinman, Thomas E. Gibson, and Adolph A. Kutzmann.*

SURGERY, GYNECOLOGY AND OBSTETRICS

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THE RADICAL OPERATION FOR TERATOMA TESTIS

AN ANALYSIS OF SEVENTY-NINE CASES, TEN OF WHICH ARE PERSONAL[1]

BY FRANK HINMAN, M.D., THOMAS E. GIBSON, M.D., AND ADOLPH A. KUTZMANN, M.D., SAN FRANCISCO

TUMORS of the testicle present two considerations not found to a like degree in tumors elsewhere. The first relates to their pathology, which is so very complex and diverse as to have aroused considerable difference of opinion as to its nature, some considering all tumors teratomatous, in origin at least, while others recognize various homologous and heterologous types. The subject is very much confused by the inclination of so many to call a testicular tumor "sarcoma," when probably a true sarcoma of the testicle is a very rare type of tumor.

Secondly, embryological and anatomical peculiarities render the surgical treatment of the condition in one way very easy, in another way very difficult. Orchidectomy is so simple and practically without risk that it appears the obvious procedure, but the fact that metastases occur primarily to the remote retroperitoneal lymphatic neighborhood of embryological origin, alongside and upon the vena cava and aorta, permits simple removal of the testicle and its tumor to cure relatively few sufferers.

In previous publications (Hinman) the combined experience of various surgeons has been analyzed and has demonstrated in suitable cases the feasibility and technical ease of the radical operation. We believe at the present time that sufficient time has elapsed and a large enough series of radical operations has accumulated, to permit of more detailed analysis and to establish the radical operation as a sound surgical procedure, on the basis of cases with lumbar metastases that have remained cured 4 years or longer following the radical operation.

Our purpose in this contribution is, therefore, to present a comprehensive analysis of all cases thus far reported, comprising a total of 83 radical operations for testicular tumors (79 for teratoma testis and 4 performed by mistake on tumors which later proved to be tuberculous or luetic in nature) including 10 personal cases, 5 of which have been previously reported (Hinman).

HISTORICAL NOTE

Operations for malignant disease in general have been progressively elaborated, until now it is a general axiom of surgery that radical *en bloc* removal of the growth with the lymphatics and lymph glands that drain the area is the only proper form of treatment. Surgeons in general have failed to apply this rule to tumors of the testicle, probably because the deep situation of the involved lymphatics and the important structures which lie near them have appeared to preclude the performance of a radical operative procedure. Consequently, they have, on the whole, been content to perform simple castration and to trust that the lymphatics are not already infiltrated. On what feeble grounds this hope is based is shown (Table II) by the

[1]From the Department of Urology, University of California Medical School, San Francisco, California.

TABLE I.—ANALYSIS OF SEVENTY-NINE CASES OF RADICAL OPERATION WITH RESPECT TO LUMBAR METASTASES

	Group I-A	Group I-B	Group II-A	Group II-B	Group III-A
	Lumbar glands palpable clinically before operation	Lumbar metastases so extensive as to be inoperable	Metastases not found in the lumbar glands that were removed	Metastatic glands found and completely removed	Incomplete data
Number of cases	9	13	25	26	6
Inoperable	8	13			
Radical removal	1	0	25	26	6
Surgical mortality	3	2	3	2	
Died of metastases	5	4	8	6	1
Lost after discharge	0	0	1	0	
Living with metastases	1	4	1		
Living and well		0	12 2 over 4 yrs.	17 4 over 4 yrs.	5
Incomplete data		3			
Accidentally killed				1	

Summary

Group I—
- Operative mortality ..... 22.7 per cent
- Morbidity to date ..... 75.0 per cent
- Probable morbidity ..... 100.0 per cent

Group II—
- Operative mortality ..... 9.2 per cent
- Morbidity to date ..... 37.2 per cent
- Living 4 years or longer ..... 6 cases
- Living over 2 years ..... 14 cases

Grand Summary

Operative deaths	10 (12.6%)
Died of metastases	24
Living with metastases	6
Living and well	34
Killed or lost	2
Incomplete data	3
Total	79

very few cases that escape subsequent recurrence in the glands. The rarity of local recurrence in the scrotum following simple castration only serves to emphasize the need of a more radical procedure.

Realization of the inefficacy of simple castration has resulted in the gradual development of a satisfactory surgical procedure in the hands of a few men who have given the subject careful thought. From a historical point of view, the evolution of the radical operation may be divided into three periods:

1. Attempts to remove clinically appreciable abdominal metastases;

2. Realization of the gravity of such procedure, its futility, and attempts to perfect the method;

3. Development of the present radical operation, made possible by exact knowledge of the lymphatic drainage of the testicle.

To the first period belong the futile transperitoneal attempts of Kocher (1882–3) followed by Bergmann and Staenger, Bland Sutton (1895), Morris, Witzel, Tuffier and Guibal, Rogovski, Staffeld, Chifolian, and others (cited by Chevassu, and Sébileau and Descomps).

In the second period we find Stinson (1897) advocating a high excision of the cord and inguinal glands. Villar extended the inguinal incision with the patient in Trendelenburg position and was able to strip up the peritoneum for a short distance and to remove the vas, the spermatic vessels, and the iliac lymphatics. Similar operations have been variously performed, but the results show no improvement over simple castration, for the reason that they do not remove the primary lymphatics of the testicle. Furthermore, experience has taught that surgical inter-

Fig. 1a. Photograph showing longitudinal section of large gumma of testicle, *C*, associated with a cyst of the epididymis, *B*, and hydrocele of the tunica vaginalis, *A*. The gross appearance is very similar to that of a seminoma and illustrates strikingly the difficulty of diagnosis on inspection at the time of operation and the value of microscopic confirmation by the frozen section method. Long diameter 13 centimeters.

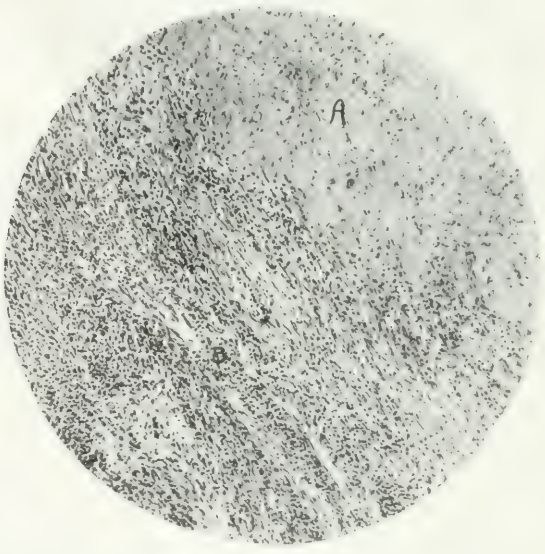

Fig. 1b. Low power photomicrograph of margin of gumma of testicle (Fig. 1a), showing gummatous tissue, *A*, and typical perivascular lymphocytic infiltration, *B*, with interstitial fibrosis and absence of giant cells and endothelial cell reaction.

vention is contra-indicated in every case in which involvement of the lumbar glands can be determined clinically.

In the third period was developed the present radical operation as a result of an exact knowledge of the primary lymph glands into which the lymphatic channels of the testicle drain, which was first established by Most, in 1899. The primary lymph zones of the testicle lie in the neighborhood of embryological origin, as would be expected, namely, retroperitoneally, along the aorta and vena cava in the lumbar region. This system has been dwelt upon at length in previous publications (Hinman).

DIAGNOSIS

The clinical recognition of testicular tumor is largely a matter of exclusion. They present no pathognomonic signs or symptoms. They may vary markedly in size, sometimes being little larger than the normal testicle, at other times reaching huge proportions. Heydenreich reports a case in which the tumor extended to the level of the knees. Usually such enlargements are complicated by hydrocele, as in this case, in which the tunica vaginalis contained 10 liters of fluid. As a rule the tumor preserves the shape of a normal testicle and has a smooth, regular surface. Nodulation and irregularities, however, may occur, but are usually late. The consistency is ordinarily one of uniform hardness, although early smooth tumors may have considerable elasticity. Occasionally there may be found areas of fluctuation due to localized necrosis or cystic degeneration. The epididymis is ordinarily easily recognizable, but in advanced cases becomes completely obliterated. The cord may be somewhat enlarged but rarely either indurated or nodular. The skin of the scrotum is commonly uninvolved and found to be freely movable over the mass. It may appear red and shiny from being stretched, or present a congested appearance from increased vascularity, large bluish veins showing through. Exceptionally is it manifestly adherent to the mass or presents an area of gangrene or ulceration.

Syphilis, hæmatocele (hydrocele), and tuberculosis present problems of differentiation.

TABLE II.—RESULTS FOLLOWING SIMPLE ORCHIDECTOMY

Author	Number of cases	Number lost from observation	Time not stated	Number of cases dead				With metastases clinically	Number of cases living							4 yr cures
				Within 1 yr	In 1 to 4 yrs.	After 4 yrs.	Total		Time not stated	Less than 1 yr	1 to 3 yrs.	3 to 4 yrs	Total	Longer than 4 yrs.	Total	
Chevassu	100		15	38	27	1	81					4	4	15	19	19%
Chevassu	S 47 T 50		7	8 28	23 11	1	31 47					4		12 3	16 3	34% 6%
Kober	70		40	All died within 3 yrs.		1 (6 yrs.)	41			18	6	2	26	8	34	13%
Nicholson	18			12			12		6 (1 to 5 yrs.)				6			
Howard	57	21	27						6 (all less than 3 yrs.)			2	8			
Hinman	24						20				1			3		
	S 9 T 6										1					
Coley	52 Orchidectomy and "Coley's serum"	14	18					9			3	3		3		
Barringer and Dean																
Group II[1]	8	2	3					8		2	3	1	3			
Group III[2]	19	6	8					19		2			5			
Group IV[3]	6	2	2							2						

S—Seminoma. T—Teratoma. [1] No Surgery. "Primary inoperable." [2] Castration plus radium—"recurrent." [3] Castration plus radium—"prophylactic."

Gumma simulates tumor more often and closely than any other condition, and it is well never to forget that generalized lues and testicular malignancy may coexist. A positive Wassermann or antiluetic therapy should not be a cause for too long delay. It is preferable to remove gumma as has been frequently done than to delay in the removal of a malignant tumor (Fig. 1, *a* and *b*).

Some cases of hydrocele and hæmatocele present great difficulties in differentiation. The pathognomonic signs of transillumination and fluctuation may fail in hæmatocele, and certain teratomata in which cartilage and mucoid material preponderate may transmit light and be fluctuant. Trauma, as the important factor in hæmatocele, may have been absent, and its significance relative to tumor is about as great anyway. Hydrocele in conjunction may completely mask the presence of tumor, and on the other hand, simple hydrocele may present hard indurated areas due to organization and absorption. Of considerable help often is puncture drainage of the vaginalis, which enables more accurate palpation of the testicle. Significant of this is the frequency in the history of tumor cases of the occurrence of numerous tappings before the true condition was even suspected.

Tuberculosis more rarely presents difficulties and only in those rare instances of massive tuberculous epididymo-orchitis. The epididymis is the seat of primary election to tuberculosis and the disease produces characteristic nodulation as it progresses. Mistaken diagnoses are possible, however, as the senior author can testify, having both performed a radical operation for tuberculosis and delayed another in seminoma, thinking it was tuberculosis. Mistakes occurred in both cases after gross inspection following orchidectomy and in consultation with an expert pathologist. It was only after careful microscopic study later that an exact diagnosis was made. Figure 2, *a* and *b* demonstrates the unusual nature of massive tuberculosis of epididymis and testicle (Compare with Figures 1, gumma, 3, seminoma, and 4, teratoma.)

The recognition of malignancy in cryptorchism is difficult. Inguinal ectopy is more apt

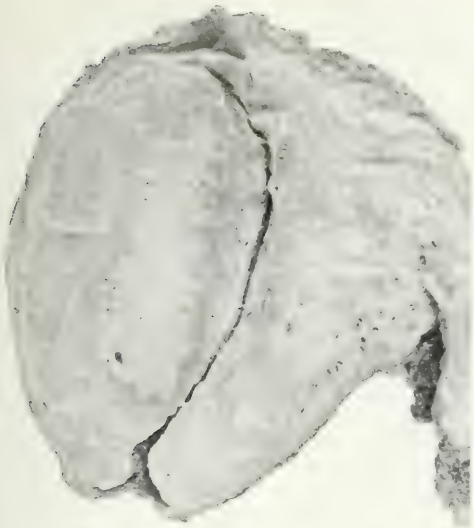

Fig. 2a. Photograph of solid testicular tumor due to massive tuberculosis. The uniform, smooth surface, absence of tubercles and of suppuration may lead to difficulty in diagnosis upon gross inspection and illustrate the need and importance of diagnosis by microscopic study of frozen sections in every case of doubt. Tumor measured 9 by 10 centimeters, the same size as the teratoma shown in Figure 4a.

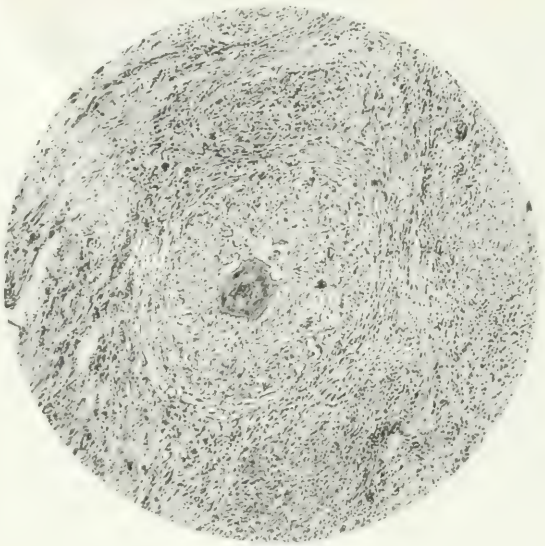

Fig. 2b. Low power microscopic view of typical tubercle, with central giant cell formation, peripheral endothelial and lymphocytic reaction and interstitial fibrosis, from gross specimen shown in Figure 2a.

to give early evidence because the anatomical position emphasizes pain and tumor. In abdominal retention, however, suspicion of the disease may be long delayed and only aroused by the appearance of an abdominal tumor, or by such secondary manifestations as neuralgia or œdema of the extremities from pressure on nerves or blood vessels. In these cases the congenital absence of a corresponding testicle in the scrotum is of great significance. The relative greater frequency of malignant change in cryptorchids has an important bearing upon the surgical correction of this deformity. Most surgeons recognize that spontaneous descent will not occur after puberty, and advise orchidopexy or orchidectomy at or before this period. Had the latter been done in all of Bulkley's 59 cases of tumor in intra-abdominal cryptorchids, 31 would have been saved.

In view of the difficulties in diagnosis, the extreme malignancy of these growths, and the simplicity of exploratory examination, the interest of the patient demands that every testicular enlargement which is in any way suspicious should be immediately inspected surgically and, when necessary, its exact nature determined by microscopic study. Delay in these cases proves fatal.

The period of primary lymphatic involvement is most variable. Extensive metastases have been found with tumors of recent onset, and *vice versa*. Autopsy and operative findings indicate that the mixed type of tumor (teratoma) spreads more rapidly than the unicellular type (seminoma) according to Chevassu. However, analysis of 79 radical operations with respect to types of tumor seems to promise an equally good prognosis for both types, and reveals furthermore the important fact that no inference as to the presence or extent of metastases can be had from a knowledge of the duration of the testicular enlargement (see Table III). Unfortunately, primary extension to the retroperitoneal lymph area gives no clinical evidence other than palpatory, and when these glands are large enough to be palpable, a late stage, probably with generalized metastases, is reached. Neither can the condition of the spermatic cord be taken as an index of extension, as microscopic studies have shown that the cord, and even the more proximal ilio-

TABLE III.—PROGNOSIS AS REGARDS DURATION AND TYPE OF TUMOR

	Seminoma			Teratoma		
	Duration	Died	Living	Duration	Died	Living
Group I-A	18 mos. 10 mos. Not stated	3 mos. 5 mos. 5 mos.				
Group I-B	8 mos. Not stated 9 mos. 6 mos. 6 mos.	31 mos. 4 mos. 13 days*	18 days 15 days	6 mos. 7 yrs.		Not stated 2 mos.
Group II-A	15 mos. 7 mos. 11 mos. 4 mos. 5 mos. 3 mos. 3 yrs. 16 mos. Not stated	5 yrs. 7 days* 7 mos. 2 mos.*	2 mos. 18 mos. 4 mos. 2 mos. 10 mos.	14 mos. 12 mos. Several yrs. Not stated Not stated Not stated 3-4 mos. 29 mos. 6 mos.	Not stated 9 mos.	28 mos. 28 mos. 12 mos. 22 mos. Lost track of 24 mos. 2 mos.
Group II-B	5 mos. 30 mos. 36 mos. 12 mos. Not stated Not stated 6 mos. 3 mos. 4 mos. 5 mos. Not stated**	8 mos.* 18 mos.	34 mos. 4 yrs. 10 mos. 8 mos. 10 mos. 8 yrs. 3½ mos. 30 mos. 8 yrs. 14 mos.	12 mos. 10 mos. 8 mos. 4 mos. 9 mos. 3 yrs. 1 mo. 7 yrs. 4 mos. 8 mos. 10 mos.	8 mos. 9 mos. 4½ mos. few hrs.*	3 yrs. 31 mos. 7 mos. 21 mos. 4¾ yrs. 2 mos. 1 mo.
Group III-A	Not stated		24 mos.			
Total		12 cases	17 cases		6 cases	16 cases
Total	29 cases			22 cases		

SUMMARY

In 79 cases of radical operation for malignant tumor of the testicle, 29 are reported as seminomata, 22 as teratomata, and 28 are indefinite. Twelve cases of seminoma are dead and 16 living; 6 cases of teratoma are dead and 16 living. Omitting Group I, which was inoperable, and the 5 cases dying of causes other than tumor, supplies us with more exact comparative figures, thus, of 16 cases of seminoma, 3 are dead, and 13 living (3 living and well over 4 years, and 2 living and well approximately 2 years or more). So far as this limited series permits of analysis, the prognosis for seminoma and teratoma is about the same. The reader will recall that Chevassu in 100 cases of simple castration found that teratoma gave a decidedly less favorable prognosis than seminoma.

*Died of cause other than tumor. **Reported as carcinoma.

lumbar glands may be free from malignancy while the more distal glands may show well-developed metastases.

The prognosis from the standpoint of pathology is indicated in Table III. In explanation of the pathological terminology, it may be said that the pathogenesis of testicular tumors has long been a subject for dispute. Current views may be divided into two groups, one championed by Chevassu, maintaining that in addition to the mixed tumors of the testicle, there exists a large group of homologous unicellular tumors of malignant nature arising from the epithelium of the seminiferous tubules, the so-called "seminoma." The other group, led by Ewing, believes, probably correctly, that practically all testicular tumors are teratomatous in origin. The subject of pathology has been dwelt upon more fully in other publications, (Hinman and Kutzmann and Gibson). For clinical purposes, it is convenient to divide testicular tumors into two large groups, which occur with about equal frequency, seminoma (Fig. 3 *a*, *b*, *c*) and teratoma (Fig. 4 *a*, *b*, *c*) Chevassu found with simple castration that the prognosis was decidedly less favorable for teratoma. In the 79 cases of radical operation, the prognosis appears about equally good for either type.

PROGNOSIS

The extremely poor outlook for patients suffering with tumors of the testicle is well recognized. Orchidectomy even with early diagnosis is a dismal failure. There is sufficient statistical evidence to prove the inadequacy

Fig. 3a. Photograph of single cell type tumor, a seminoma. At the inner edge of the left half of the specimen is seen a small compressed remnant of the testicle. Usually no normal testicular tissue can be found. The tumor measured 5 by 7.5 centimeters.

of simple castration (see Table II). Obviously the procedure in order to cure must antedate extension outside the testicle, and this it has done in less than 15 per cent of the cases. A mortality after surgery of over 80 per cent is appalling, and that castration must be supplemented by radium, X-ray, or more radical surgery is apparent if any considerable improvement in treatment is to be gained.

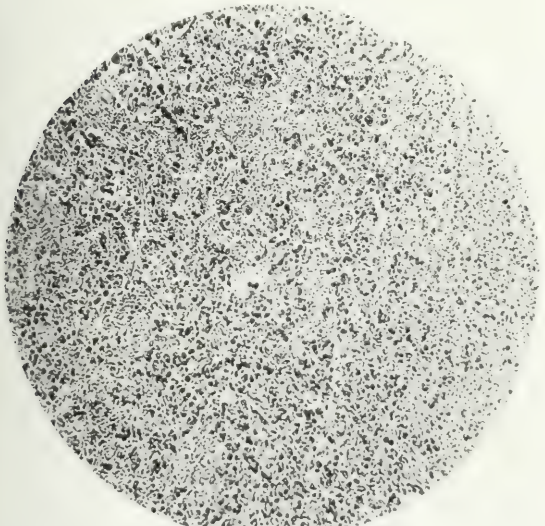

Fig. 3b. Photomicrograph (low power) of a seminoma, a uniform picture of large, round, vesicular cells resembling the spermatoblasts. This is the type of tumor which probably has been so frequently wrongly diagnosed as sarcoma.

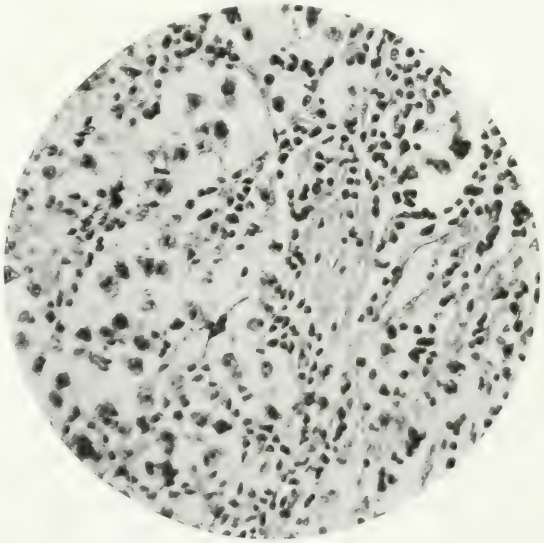

Fig. 3c. Photomicrograph (high power) of a seminoma. The uniform round vesicular cell distributed in a lymphoid stroma is characteristic. The nucleus is large and shows fine stippling as seen in spermatoblasts and generally one or two large nucleoli.

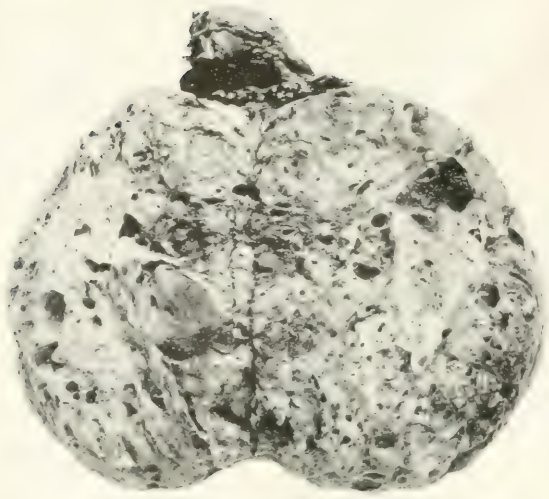

Fig. 4a. Photograph of a mixed cell type of tumor, a teratoma. No normal testicular tissue is seen. Multiple dissimilar areas characteristic of different types of tissue such as cartilage, gland, and single cell forms give a totally different picture from that of Figure 3a. The size of the tumor was 9 by 10 centimeters.

The results of Barringer and Dean in a 4 years' systematic use of radium are far from encouraging (see Table II). They report one remarkable case in which a large abdominal metastasis was palpable in the right pelvic region. Radium packs were placed over this mass before and after castration and within a month it had melted away so that it could no longer be felt. Examination of the testicular tumor proved it to be a teratoma (Ewing). The patient reports that he is entirely well now—3 years and 5 months after he was first seen.

In Béclère's case of seminoma treated by castration and followed 2 years later by a large tumor filling two-thirds of the abdomen, it does not seem likely that the mass was a recurrence but rather a splenic enlargement, since as a result of radium treatment the patient has been living and well for 5 years.

Taylor, in England, reports a striking instance of the result of radium in the case of a physician, aged 33, who was an inguinal cryptorchid (left). He had been operated upon for hernia at the age of 30 and the testicle was brought down into the scrotum. A year later he developed a malignant tumor of that testicle and simple castration was done. Eight or nine months later he developed a recurrence in the left iliac fossa, which was deemed inoperable. This mass was about the size of a cocoanut and compressed the vessels, causing œdema of leg and steadily increasing pain so that he was confined to bed and kept under the influence of morphine. On two occasions (6 to 7 weeks apart) radium was introduced by open operation into the mass, and on the first occasion a bismuth salt was introduced as well, so that the tumor might be subjected to the secondary rays given off by the bismuth as a result of its exposure to radium. The tumor decreased markedly in size, the patient recovered his health and was able to walk, dance, fish, and play golf. He was surgeon on the *Lusitania* for a time and remained perfectly well for 18 months. He developed glands in the neck, had hæmoptysis and a rapidly fatal issue supervened. The growth was carcinoma microscopically.

Cacciatore (Buenos Aires) reports a case of local recurrence shortly after castration treated with radium, with temporary relief. Three applications of radium were given. Abdominal metastases occurred and the patient died 6 months after operation. The diagnosis was "angio-myxosarcoma."

Levin states that the highly specific action of radium on the testicular cells undoubtedly explains the remarkable beneficial effect of radium on malignant tumors of the testicle. The rays destroy the spermatogenic elements without apparent injury to the other elements. French authors advocate radiotherapy upon this theoretical consideration. Accordingly the seminoma derived from the spermatoblasts is regarded as especially amenable to radiotherapy, while the mixed tumors may not be necessarily more susceptible than other tumors (Sébileau and Descomps). Barringer and Dean state that the more embryonal types of teratoma (regarding all cases as teratoma according to Ewing's classification) react most favorably. This statement is not at variance with the French view, since according to Ewing the seminoma falls in the class of teratoma of embryonic type (embryonal carcinoma).

The X-ray has also been used in the attack on these tumors. Orbaan's is the only system-

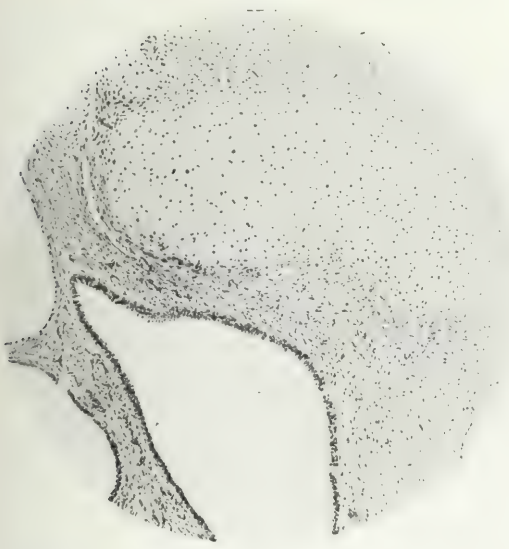

Fig. 4b. Photomicrograph (low power) of a teratoma showing area of cartilage and three cystic spaces, each lined with a different type of epithelium, cuboidal, short columnar, and high columnar.

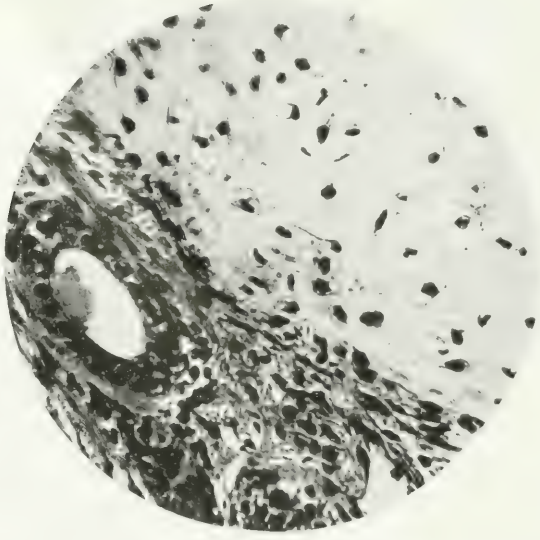

Fig. 4c. Photomicrograph (high power) at the edge of the area of cartilage in Figure 4b, but with a small epithelial lined cyst surrounded by connective tissue stroma invaded at portions of the outer rim of the cyst wall by malignant tumor cells.

atic study available. He reports nine cases treated before and after castration. Eight of these showed clinical evidence of recurrence when X-ray treatment was instituted. Six cases have died and three are living 24, 25, and 30 months, respectively, after starting X-ray treatments, and the patient living 25 months still shows clinical evidence of metastases. Metzmacher cites a temporary check in the progress of a recurrence after

TABLE IV.—SEVENTY-NINE CASES OF RADICAL OPERATION

Time elapsed since operation	Group I-A: Lumbar glands palpable clinically before operation		Group I-B: Lumbar metastases so extensive as to be inoperable		Group II-A: No metastases found in lumbar glands removed		Group II-B: Metastatic glands found and completely removed		Group III-A: Incomplete data		Total	
	Dead	Living	Dead	Living	Dead	Living	Dead	Living	Dead	Living	Dead	Living
0– 6 mos.	6[3]	1*	5[2]	3*	4[3]	3	4[2]	4	. .	. .	19	11
7–12 mos	1	. .	. .	. .	3	2, 1*	4	3	1	. .	9	6
13–18 mos.	1	. .	. .	1*	1	. .	1	1	. .	. .	3	2
19–24 mos.	. .	. .	. .	. .	1	3	. .	1	. . .	1	1	5
25–30 mos.	.	. .	. .	. .	.	2	.	1	. . .	. .	. . .	3
31–36 mos.	.	. .	1	. .	.	.	.	.	. . .	. .	. . .	3
37–42 mos.	.	. .	. .	. .	.	.	.	.	. . .	. .	1	. .
43–48 mos.	. .	. .	. .	. .	1	2	. . .	4	. . .	. .	. . .	. .
over 48 mos	. .	. .	(3)	. .	1	(1)	. . .	. . .	. .	4	1	6
Not stated.	. .	. .	. .	. .	. .	. .	. .	. .	. .	. .	1	4
Total.	8	1	6 (3)	4	11	13(1)	9	17	1	5	35**	40

SUMMARY

Thirty-four cases dead, 40 living; 6 of 40 cases living have metastases, leaving 34 cases living and well. Four cases (indicated by parentheses) not stated (killed or lost). Ten cases (indicated by co-efficients above—[2], [3]) are included in the surgical mortality. Six cases (indicated by asterisks above) are living with metastases. It is to be noted that deaths after operation occurred almost always within the first year, and cases surviving this period in good health have a fair guarantee of cure. A point of prime importance in support of the radical operation as against simple castration is the fact that 4 cases having lumbar metastases have remained cured over 4 years since operation 12 of these are living and well 8 years after operation).

**This figure includes 1 case accidentally killed, and the 10 cases of surgical mortality, leaving 24 dead from metastases.

castration by the use of X-ray, although the patient died. One case in the writer's series of radical operations is of interest here. Large masses which were not palpable through a thick muscular abdominal wall were discovered upon retroperitoneal exposure. Several X-ray treatments have kept them stationary at least, as the patient, only recently examined, shows no palpable nodules and is active and in good health 19 months after castration and has gained 30 pounds in weight (Hinman, Case 8).

While the reports of radiotherapy are too few to prove or disprove its value, its use as a palliative measure and in conjunction with surgery as curative seems justified by the few apparently brilliant results recorded.

The poor results following simple castration for teratoma testis have stimulated surgeons to apply the well-recognized principle in the treatment of cancer elsewhere to this condition and attempt a radical removal of the primary lymph zone with the testicle. A period of 4 years or longer has passed after the performance of the operation in a sufficient number of cases to give an estimation of its merits (Table IV). Obviously those patients from whom lumbar lymph nodes with metastatic cancer were removed at operation, who have survived 4 years or longer, may be regarded as cured by reason of the radical treatment. Simple orchidectomy would have been of no avail in any one of these cases. In another group, however, careful microscopic study of the preaortic lymph area removed at operation failed to show any evidence of metastases, and it might appear that the radical operation was unnecessary were it not for the fact that four of these cases have since died with postoperative metastases to this same lymph area, a result which clearly indicates that the original operation, rather than being unnecessary because of the failure to find metastases, was insufficiently radical because failure completely to remove the whole lymph area is the only possible explanation of the subsequent appearance of metastases here. It is admittedly possible that a negative finding of glandular invasion of the lymph area removed in those who survive is an error either of microscopic recognition in the case of very early involvement, or of incomplete search, and that simple removal of the testicle would have failed to cure some of these. Nevertheless, a certain number of patients (15 per cent) will be cured by simple orchidectomy, as statistics show, and in these the radical operation is theoretically unnecessary. But the recognition of this small group is impossible clinically, and it is absolutely necessary to sacrifice them to radical treatment in the interest of the majority.

The results and findings in the 79 cases of attempted and successful radical resection are indicated in the accompanying tables (see Tables I, IV, and V). There were 22 inoperable cases, group I, in which the disease was so far advanced as to render them unsuitable for radical treatment. In 9, large lumbar masses were palpable clinically before operation, and in 13, metastastic nodes too extensive for surgical removal were found at operation. All but 5 have died, and these are doomed, the average period since operation that they have been followed being only 17 days. Six of the 22 died in the hospital as a result of the operation (shock 3, pneumonia 1, embolism 1, peritonitis 1). The morbidity of this group is 100 per cent.

In 51 cases, Group II, more or less successful removal of the lymphatic drainage system was accomplished. Five of these failed to survive operation—an operative mortality of 9.2 per cent. Fourteen cases have since died of metastases, and 11 of these are known to have died within 1 year. Twenty-nine cases are reported as living and well for 2 months to 10 years since radical operation, and it is worthy of emphasis that 6 of the 29 have outlived the four-year-time period for cure. Four of these six cures had metastatic invasion of the lymph tissue removed and all four are alive directly by virtue of the clean, complete removal of this metastatic lymph area. Chevassu, 1, living and well 4 years and 10 months; Descomps, 1, living and well 8 years; Hinman, 1 (Eloesser), living and well 8 years; Hinman, 3, living and well 4 years, 7 months).

Consideration of these findings in comparison with what simple orchidectomy alone might have accomplished in this same series

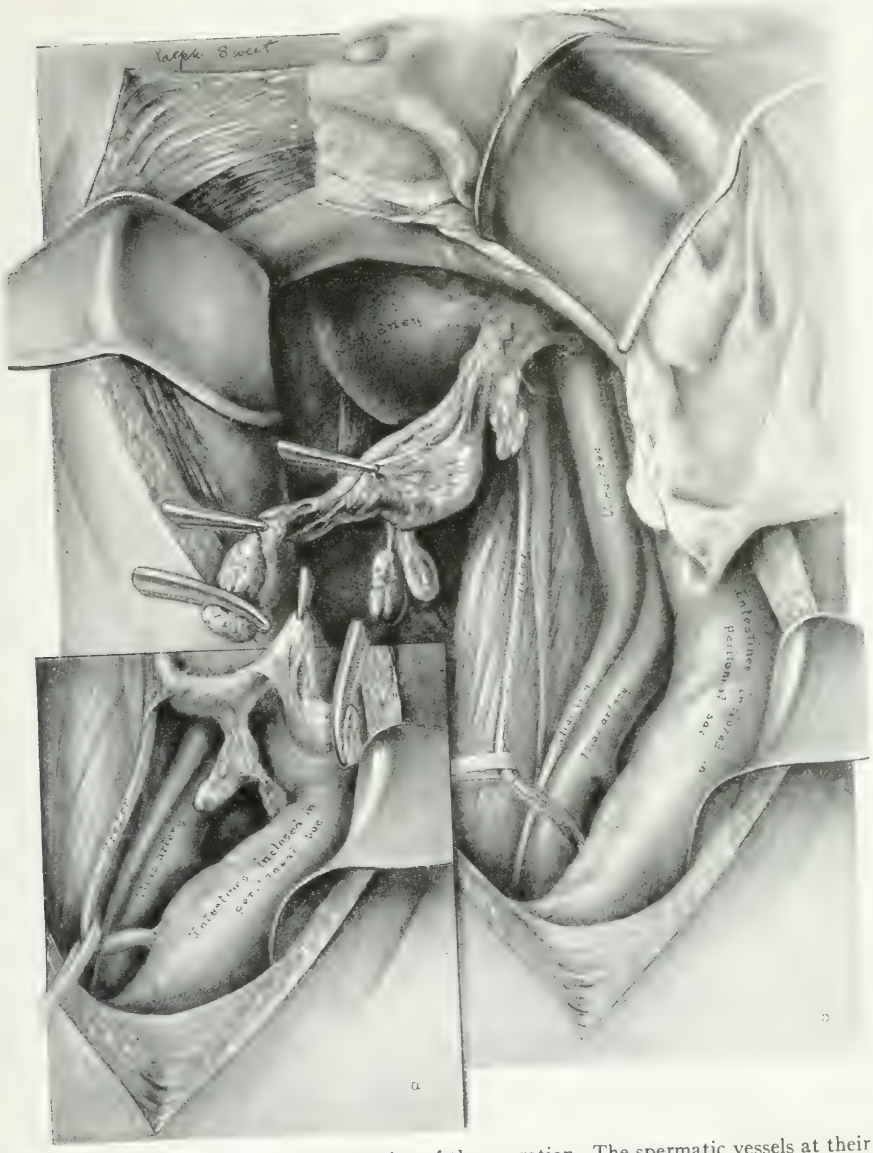

Fig. 6. Drawing to show completion of the operation. The spermatic vessels at their point of junction with the abdominal vein and artery have been isolated, ligated, and divided before resection is attempted, which may then be carried out from above downward or from below upward.

TABLE V.—ANALYSIS OF CASES OF RADICAL OPERATION

GROUP I.—INOPERABLE CASES

A—Cases with Metastatic Lumbar Nodes Palpable Before Operation

Author	Date of operation	Age, years	Duration	Side	Clinical metastases	Operation and microscopical diagnosis	Died postoperative	Metastases	Living
1. Gregoire[4] Case 2	4-8-07	42	18 mos.	R	Abdominal masses palpable	Radical. Hard irregular mass on vena cava. Few glands removed for examination. Diagnosis: seminoma.	3 mos.		
2. Gregoire[1,4] Case 3	8-1-07	40	10 mos.		None at time of castration. Lumbar glands felt at time of radical	Castration 8-10-06 Radical 8-1-07. Hard diffuse mass upper limits of which could not be felt. Mass surrounded ureter. Operation confined to freeing this. Diagnosis: seminoma.	17 mos. after castration. 5 mos. after radical	Viscera and lumbar glands	
3. Fredet[2,4]	4-24-09	27		L	Mass in left iliac fossa. Lumbar region negative cord infiltrated	Radical. Large adherent mass in left iliac fossa. Enlarged adherent glands about aorta. Left lumbar gland size of almond. Fragments removed for examination. Diagnosis: seminoma.	5 mos. †	Lumbar glands	
4. André	Not stated. Reported 5-8-12	40	8 mos.	L	Lumbar glands and mass near hilus of kidney size of walnut felt	Radical. 1 gland lower pole of kidney, 3 in angle formed by aorta and renal vessels removed. Suspicious induration higher up which could not be removed.			Lost from observation after discharge 2 weeks
5. Pillet	Not stated. Reported 1913	37			Iliac and inguinalglands palpable	Radical with removal of all glands.	1 yr. †	Lumbar glands	
6. Georgesco and Savesco Case 2	Not stated. Reported 1914	24	1 yr.		Lumbar glands palpable	Radical exploratory incision with removal of testicle and cord. Abdominal mass inextirpable.	15 days‡ Pneumonia	Lung, spleen,and lumbar glands	
7. Descomps Case 5	Not stated. Reported 1920	40		R	Metastases recognized 3 mo. after onset. Patient emaciated.	Radical exploratory incision with incomplete removal of large lumbar masses.	48 hrs. Shock	Lumbar glands	
8. Descomps Case 6	Ibid.	40		R	Metastases recognized at 4 mo. Patient emaciated	Radical exploratory incision with incomplete removal of large preaortic masses.	48 hrs. Shock	Lumbar glands	
9. Descomps Case 7	Ibid.	40		L	Metastases recognized at 6 mo. Patient emaciated	Radical exploratory incision. Inextirpable masses about aorta. Partial removal.	1 mo.	Lumbar glands	

†No autopsy. ‡Iliac juxta- and pre-aortic glands enlarged and confluent mass size of fist, between kidney and aorta. Nodules in spleen and lung. 1 cancerous subclavicular gland.

[1]Cited by Mascarenhas. [2]Cited by Delbet. [3]Cited by Chevassu. [4]Cited by Sébileau and Descomps.

of 79 cases is favorable to radical surgery. Orchidectomy could have been curative only when applied in the 25 cases of Group II-A, in which no invasion of the lymph area was demonstrable. Eight of these cases have since died of metastases, and they would not have survived after simple castration. Even granting that castration cured the remaining 13 cases, which is granting too much, it would cure only about 16 per cent of the 79 cases.

The large group of 26 cases (Group II-B), which had early metastases to the primary lymph zone, would have received no benefit by orchidectomy alone, whereas the statistics show that at least 4 of these have been cured by the radical and clean removal of this area (living and well over 4 years), that 17 others are still living and well—8 for almost 3 years, —and that it is, therefore, reasonable to expect a fair proportion of the 17 also to be

TABLE V.—ANALYSIS OF CASES OF RADICAL OPERATION—*Continued*

GROUP I.—INOPERABLE CASES—*Continued*

B.—Cases in Which Inoperable Lumbar Nodes Were Found after Retroperitoneal Exposure

Author	Date of operation	Age, years	Duration	Side	Clinical metastases	Operation and microscopical diagnosis	Died post operative	Metastases	Living
1. Gregoire [1, 2, 3, 4] Case 1	4-20-05	33	8 mos.	R	None	Long inguinoscrotal incision extending to twelfth rib and then anteriorly along costal margin. Peritoneum stripped up to expose renal pedicle and abdominal vessels. Vena cava surrounded by mass of hard glands; 1 size of pigeon egg removed, others inoperable. Diagnosis: seminoma.	31 mos.	Lumbar glands	
2. Mauclaire [2] Case 3	Not given Reported 1907					Radical operation. Retroperitoneal metastatic glands inextirpable.			
3. Mauclaire [2] Case 4	Not given Reported 1907			L		Radical. Found inoperable retroperitoneal mass, so was content to explore region of renal pedicle.		Local and and lumbar metastases	
4. Barbier [1]	7-5-10	43		L	None	Radical. Large adherent gland mass about the aorta. Inoperable. Diagnosis: epithelioma.	3 mos.	Yes	
5. Duval [1] Case 1	4-12-10	29			None	Radical. One gland removed from large inoperable mass. Diagnosis: seminoma.	4 mos.		
6. Duval [1] Case 2	11-8-10	37	5 yrs.	R	None	Radical. Large mass of metastatic glands in region of cœliac axis inoperable. 2 glands removed for study. Diagnosis: epithelioma.	3 to 4 mos.	Viscera and lumbar glands	
7. Picot [1, 4]	4-25-12	35	9 mos.	R	None	Radical. Enlarged glands extending up to renal pedicle and behind left renal vein, removed. Weight 52 grams. Other inextirpable masses on left. Diagnosis: seminoma.			18 days postoperative Metastases present
8. Patel Case 1	Mar. 1913	18	6 mos.		None	Radical. Large inextirpable glandular metastases at bifurcation of vena cava. Diagnosis: teratoma.			
9. Georgesco and Savesco Case 3		36	6 mos.		None	Radical. Inoperable mass found on aorta. Diagnosis: seminoma.			15 days postoperative. Metastases present
10. Descomps Case 4	8-17-17	25	6 mos.	L	None	Radical. Inextirpable masses found on aorta. Diagnosis: seminoma.	13 days Embolism		
11. Roberts	10-16-01	38	14 mos.		None	Castration July, 1900. Operation for local recurrence July, 1901. Oct. 16, 1901—long median abdominal incision. Unsuccessful attempt to remove enlarged lumbar glands transperitoneally. Diagnosis: embryonal carcinoma.	6 wks. Peritonitis		
12. Hinman Case 8†	1-6-21	34	7 mos.	L	None	Castration Dec. 1, 1920. Radical Jan. 6, 1921—Removal of cord and spermatic vessels. Gland size of olive removed from bifurcation of aorta, and several large glands removed along aorta above bifurcation. Mass size of hen's egg at renal pedicle not removed. Given repeated X-ray treatments over abdomen post-operative. Diagnosis: seminoma.			Living and well 18 mos. postoperative gained 30 pounds. No metastases palpable
13. Young* Case 5	4-20-22	30	7 yrs.	R	None	Radical. Inoperable masses on aorta at level of renal pedicle. Diagnosis: teratoma.			2 mos. X-ray shows metastases to lung

†Previously reported. *Personal communication. [1]Cited by Mascarenhas. [2]Cited by Delbet [3]Cited by Chevassu. [4]Cited by Sébileau and Descomps.

SUMMARY OF A:

Operative deaths	3
Died of metastases	5
Living	1
Total	9

SUMMARY OF B:

Operative deaths	2
Died of metastases	4
Living with metastases	4
Incomplete data	3
Total	13

SUMMARY OF 22 CASES, GROUP I:

Operative mortality	22.7 per cent
Morbidity to date	75.0 per cent
Probable morbidity	100.0 per cent

TABLE V.—ANALYSIS OF CASES OF RADICAL OPERATION—*Continued*

GROUP II.—SUCCESSFUL RESECTION OF PRIMARY LYMPH AREA

A—No Invasion of Lymph Glands

Author	Date of operation	Age, years	Duration	Side	Clinical metastases	Operation and microscopical diagnosis	Died post-operative	Metastases	Living post-operative	Metastases present
1. Mauclaire[2] Case 1	1905				None	Radical—no glands found.			8 yrs.	Excised in scar 5 years and 8 years post-operative
2. Chevassu Case 2	11–6–09	31	15 mos.	L	None	Radical—no glands found. Diagnosis: seminoma.	5 yrs. †	Lung		
3. Chevassu[1] Case 3	10–31–11	28	7 mos.		None	Radical—removed 18 glands including 1 small one from iliac where it crosses ureter, 3 small pre-aortic, 1 small gland behind aorta on vertebral column, 1 gland beneath renal vessels and 3 glands in angle formed by aorta and iliac artery. Glands showed inflammatory reaction but no metastases.	7 days Peritonitis ‡			
4. Morestin[2, 4] Case 1	1910	50		L	None	Radical—no glands found (patient obese and alcoholic; anæsthetic poorly taken). Diagnosis: malignant tumor.	48 hrs. Pneumonia †			
5. Morestin[1, 4] Case 2	2–3–11	27	11 mos.	L	None	Radical—7 iliac glands removed. No lumbar glands found. 4–20–11 supraclavicular gland removed. Diagnosis: seminoma.	7 mos. §	Left kidney and lumbar glands		
6. Jacob[1, 4]	10–7–11	22	4 mos.	R	None	Radical—numerous glands removed from vena cava and 3 or 4 from iliac fossa. Diagnosis: seminoma.			2 mos.	None
7. Gregoire Case 5	1910	34	3 mos.	R	None	Radical—no glands found.			10 yrs.	None
8. Gregoire Case 6	5 10–15	46	5 mos.	L	None	Radical—removal of tumor and regional lymph glands. Diagnosis: seminoma.	18 mos. †	Probably lung		
9. Duval[1] Case 3	2–20–11		3 mos.		None	Castration 2–14–11. Radical 2–20–11. 3 glands removed—1 on aorta at renal pedicle, 1 pre-aortic, and 1 at bifurcation of aorta. Diagnosis: epithelioma.	9 mos.	Lumbar glands		
10. Duval[1] Case 4	12–12–11	44	8 mos.	R	None	Radical—no glands found.			18days	None
11. Delbet	2–18–10	43	14 mos.	R	None	Castration 2–14–10. Radical 2–18–10. 1 gland adherent to vena cava removed. No other glands found. Diagnosis: teratoma.			28mos.	None
12. Michon[2, 4] Case 1	1–29–10	25	12 mos.	L	None	Radical—2 small glands removed from aorta. Diagnosis: teratoma.			28mos.	None
13. Michel[4]	7–27–10	32	3 mos.		None	Radical—1 small gland in spermatic sheath removed. Diagnosis: seminoma.	2 mos. Pneumonia			
14. Pringle*	3–20–12	28	Sev. yrs.	L	None	Radical—lumbar iliac, and inguinal glands removed *en masse*. Diagnosis: teratoma.			2 yrs.	None

*Personal communication. [1]Cited by Mascarenhas. [2]Cited by Delbet. [3]Cited by Chevassu. [4]Cited by Sébileau and Descomps.
‡No metastases found. §Large lumbo-aortic masses with invasion of lower pole of left kidney. †No autopsy.

TABLE V.—ANALYSIS OF CASES OF RADICAL OPERATION—*Continued*

GROUP II.—SUCCESSFUL RESECTION OF PRIMARY LYMPH AREA—*Continued*

A—No Invasion of Lymph Glands—*Continued*

Author	Date of operation	Age, years	Duration	Side	Clinical metastases	Operation and microscopical diagnosis	Died post-operative	Metastases	Living post-operative	Metastases present
15. Lapointe and Alberstadt[4]	11-30-12	39	8 mos.	R	None	Castration 11-13-12. Radical 11-30-12. 2 small glands at iliac bifurcation; several glands where ureter crosses iliac, also on vena cava and aorta removed. Diagnosis: epithelioma.	6 mos.	Liver, lung		
16. Georgesco and Savesco Case 1		35	3 yrs.		None	Radical—1 gland removed from iliac fossa and 1 from aorta to which it was adherent. Diagnosis: seminoma.			9 mos.	Symptoms of hydronephrosis
17. Barringer* Case 1	Reported in 1921				None	Radical—2 enlarged glands found high up in spermatic chain, showing chronic interstitial and hyperplastic inflammation. Radium emanations given. Diagnosis: teratoma.			22mos.	None
18. Barringer* Case 2	Reported in 1921				None	Radical—no suspicious glands found, so radium not used. Diagnosis: teratoma (chorioma).		Lung		
19. Barringer* Case 3					None	Radical—no suspicious glands found, so radium not used. Diagnosis: teratoma.			Lost track of	
20. Young* Case 1	11-24-14	36	18 mos.	R	None	Radical—glands not stated.	2 yrs.	Lumbar glands		
21. Young* Case 3	4-17-19	29	3 to 4 mos.	L	None	Radical—no metastatic glands. Diagnosis: teratoma.			2 yrs.	None
22. Hinman† Case 2	12-13-17	33	29 mos.	R	None	Radical—1 macroscopic gland at point where ureter crosses iliac. Diagnosis: teratoma.	9 mos.	Lungs and lumbar glands		
23. Hinman Case 9	6-30-22	30	6 mos.	R	None	Radical—removal of iliac and pre-aortic glands with spermatic sheath up to renal pedicle. Diagnosis: teratoma.			8 mos.	Clinical evidence of visceral metastasis
24. Hinman (Hepler) Case 10	June, 1922	26	16 mos.	R	None	Radical—3 large glands removed from iliac vessels, and 1 from between aorta and vena cava 2 centimeters below renal pedicle. Diagnosis: seminoma.			2 mos.	None
25. Lipschutz	12-31-20	45	Not stated. Sudden increase in size 6 days before	R	None	Radical—no glandular metastases found. Testis undescended inguinal. Given Coley's serum and radiotherapy postoperatively. Diagnosis: seminoma.			10mos.	None

*Personal communication. †Case previously reported.
[1]Cited by Mascarenhas. [2]Cited by Delbet.
[3]Cited by Chevassu. [4]Cited by Sébileau and Descomps.
Metastases both lungs and liver.

SUMMARY OF A

Operative deaths	3
Died of metastases	8
Living	13 (over 4 yrs., 2)
Lost after discharge	1
Total	25

cured, inasmuch as the great majority of those who die of metastases die within 1 year (11 of 14). Radical operation even now is seen to have improved the results of treatment of teratoma testis over orchidectomy 100 per cent, and in suitable cases we can expect a cure of 30 per cent or more instead of the appalling 15 per cent, as formerly.

TREATMENT

Present knowledge of the clinical course, diagnosis and prognosis of teratoma testis

TABLE V.—ANALYSIS OF CASES OF RADICAL OPERATION—*Continued*

GROUP II.—SUCCESSFUL RESECTION OF PRIMARY LYMPH AREA—*Continued*

B—Metastatic Extension to Lymph Glands

Author	Date of operation	Age, years	Duration	Side	Clinical metastases	Operation and microscopical diagnosis	Died Post-operative	Metastases	Living post-operative	Metastases present
1. Caulk[1] Case 1	8-26-06	26	12 mos.	L	None	Castration 4-21-06. Radical 8-26-06. 1 lumbar gland showed metastases. Diagnosis: teratoma.			8 yrs.	None
2. Gregoire[2] Case 4	4-10-08	21	10 mos.	R	None	Radical—6 glands removed: 3 from vena cava, one at bifurcation of aorta, and 1 on iliac vein where ureter crosses. Latter, only, showed metastasis. Diagnosis: teratoma.	8 mos.	Lung; none clinically in lumbar glands		
3. Gosset[3]	2-6-09	32	5 mos.	L	None	Radical—removed 3 glands below hilus of kidney, 1 on ureter 5 cm. from renal pedicle, and 3 at bifurcation of exterior iliac. All lumbar glands showed metastases. Diagnosis: seminoma.			34 mos.	None
4. Chevassu* Case 1	7-7-09	22	30 mos.	R	None	Radical—removed 3 glands on vena cava, 2 between vena cava and aorta and 1 iliac gland. Showed metastases. Diagnosis: seminoma.			1 yrs. 10 mos.	None
5. Bland Sutton	Sept. 1909	31	8 mos.	R	None	Radical—explored lumbar region removing glands which were palpable. Found 1 gland size of haricot bean on vena cava at level of third lumen vertebra which was malignant. Diagnosis: teratoma.			2 yrs. 7 mos.	None
6. Vautrin	Apr. 1910	22	8 mos.		None	Radical—1 gland size of hazel nut on internal iliac, 1 below renal pedicle, 1 on aorta.	1 mo.	Probably in spleen		
7. Michon Case 2	2-25-11	31	1 yrs.	R	None	Radical—removed gland 25 cm. in diameter from anterior surface of vena cava which showed malignancy. 1 iliac gland removed showing only an inflammatory reaction. Diagnosis: seminoma.			8 mos.	None
8. Gayet	10-28-10	19	10 yrs. before pain, increase in size 15 days before sudden increase	R	None. Scrotum ulcerated	Radical—removed large gland from iliac where ureter crosses (malignant), and chain of glands from vena cava and aorta. Diagnosis: embryonal epithelioma.	25 days Pneumonia. Alcoholic nephritis.	No lumbar gland metastases		
9. Howard*	1912	16	10 wks.	L	None	Radical—removed numerous glands along aorta.	1 yr.	General, and in lumbar glands		
10. Dew	3-5-11	17	3 mos.	R	None	Radical—*en bloc* removal of testis (undescended inguinal) and gland bearing area. 1 gland 1 cm. in diameter removed separately at level of renal pedicle on vena cava showed metastases. Other glands not examined. Diagnosis: teratoma.	9 mos.	General abdominal and lumbar		

[1] Personal communication.
[2] Cited by Mascarenhas.
[3] Cited by Delbet.
[3] Cited by Chevassu.
[4] Cited by Sébileau and Descomps.

TABLE V.—ANALYSIS OF CASES OF RADICAL OPERATION—*Continued*

GROUP II.—SUCCESSFUL RESECTION OF PRIMARY LYMPH AREA—*Continued*

B. Metastatic Extension to Lymph Glands—*Continued*

	Author	Date of operation	Age, years	Duration	Side	Clinical metastases	Operation and microscopical diagnosis	Died post-operative	Metastases	Living post-operative	Metastases present
15.	Maragliano[1]	7-4-11	30	1 yr.	R	None	Castration 7-3-11. Radical 7-4-11. Removed 3 glands in iliac fossa, one 3 cm. long, another mid-aortic 4 cm. long, another at aortic bifurcation 3 cm. long, and 5 between aorta and vena cava 11 cm. long. Latter showed metastasis. Diagnosis: seminoma.			10mos.	None
16.	Descomps Case 1	8-18-11	24		L		Radical—24 glands removed. Gland metastases present. Diagnosis: seminoma.			8 yrs.	None
17.	Descomps Case 2	9-16-14	37		L		Radical—removed 62 glands (1 large). Gland metastases present. Diagnosis: seminoma.	8 mos. Killed in accident	None		
18.	Descomps Case 3	1-15-20	40	6 mos.	L	None	Radical. (Duration of operation 1 hour 22 glands removed (1 spermatic, 9 iliac, 10 lumbar), all malignant with exception of 1 large lumbar node about which there is doubt. X-ray postoperative. Diagnosis: seminoma.			3½ mos.	None
19.	Lister	1914	41		R	None	Radical—lumbar glands did not appear enlarged, but were sarcomatous on microscopic examination (inguinal cryptorchid. Diagnosis: sarcoma.			3 wks.	None
20.	Matas	1-15-15	28	9 mos.	L	None	Castration 12-19-14. Radical 1-15-15. Malignant glands removed. Diagnosis: teratoma	3½ mos.	Lung		
17.	Mauclaire Case 5	1922	48	3 yrs.	R	Palpable glands in groin. Skin adherent to tumor. Œdema of thigh and scrotum.	Radical—including excision of inguino-crural glands and adherent scrotum. Glands removed from iliac vessels and vena cava. Diagnosis: teratoma (chorioma).			7 mos.	None. (Œdema increased due to excision of lymphatics supposedly
18.	Young* Case 2	1-2-15	34	3 mos.	R	None	Dec., 1914, castration and removal of inguinal glands. Testis and glands showed sarcoma. 1-2-15 radical operation. Several glands removed, malignant. Diagnosis: sarcoma, probably seminoma.			2 yrs. 6 mos.	None
19.	Young* Case 3	10-10-20	24	11 mo.	R	None	Radical—metastastic glands removed. Diagnosis: teratoma.			21 mos.	None
20.	Hinman† Ebeseer Case 1	11-20-14	30	3 mos.	R	None	Castration 10-27-14. Radical 11-20-14, performed because of recurrence in stump of cord 1 small gland removed. Diagnosis: seminoma.			8 yrs.	None
21.	Hinman† Case 3	1-29-18	36	7 yrs.	L	None	Radical—numerous small glands along iliac vessels and 1 large gland at renal pedicle removed in *en bloc* dissection. The latter was malignant. Diagnosis: teratoma.			4½ yrs.	None

†Case previously reported.
*Personal communication.
[1]Cited by Mascarenhas.
[2]Cited by Delbet.
[3]Cited by Chevassu.
[4]Cited by Sébileau and Descomps.

TABLE V.—ANALYSIS OF CASES OF RADICAL OPERATION—*Continued*

GROUP II.—SUCCESSFUL RESECTION OF PRIMARY LYMPH AREA—*Continued*

B—Metastatic Extension to Lymph Glands—*Continued*

Author	Date of operation	Age, years	Duration	Side	Clinical metastases	Operation and microscopical diagnosis	Died post-operative	Metastases	Living post-operative	Metastases present
22. Hinman† Case 4	7-27-18	16	4 mos.	R	None	Radical—a large metastatic gland was found and removed which was very adherent to vena cava at level of lower pole of right kidney. Diagnosis: teratoma.			2 mos.	None
23. Hinman† Case 5	Aug. 1918	29	5 mos.	R	None	Radical—large gland removed from aorta and vena cava 5 cm. below renal pedicle. Diagnosis: seminoma.	18 mos.	Right kidney and lumbar glands		
24. Hinman Case 7	1-5-21	24	18 mos.	L	None	12-27-20—Testis and epididymis removed, and through perineal incision 1 vesicle and vas were removed. Diagnosis TB clinically. 1-5-21—Radical—for teratoma testis. A chain of enlarged glands was found running along iliac vessels and up to renal pedicle. Large malignant gland removed at level of renal pedicle. Diagnosis: teratoma.	Few hrs.	Acute cardiac dilatation		
25. Asteriades	1921	35			None	Radical operation—metastatic gland size of millet seed removed where ureter crosses iliac. Diagnosis: carcinoma.			1½mos.	None
26. Young* Case 6	10-16-22	33	10 mos.	L	None	Radical operation — unusually large lumbo-aortic glands removed just level of renal pedicle. Diagnosis: teratoma.			Not stated	None

†Case previously reported. [1]Cited by Mascarenhas. [3]Cited by Chevassu.
*Personal communication. [2]Cited by Delbet. [4]Cited by Sébileau and Descomps.

SUMMARY OF B

Operative deaths	2	
Died of metastases	6	
Living	17	(over 4 yrs., 4)
Accidentally killed	1	
	26	

SUMMARY OF 51 CASES, GROUP II

Operative mortality	9.2 per cent
Morbidity to date	37.2 per cent
Living 4 years or longer	6 cases
Living over 2 years	14 cases

emphasizes the following points of treatment: An early and accurate diagnosis of every testicular enlargement is essential, and in every case of reasonable doubt there should be no hesitation in exposing the tumor to surgical inspection, and whenever necessary performing castration and subjecting the tissue to immediate microscopic examination. Hæmatocele and massive tuberculosis require surgery, so that, by adopting such a policy, the only possible sacrifice is that of an occasional gumma of the testicle. Too many malignant growths have been neglected through uncertainty in diagnosis. Repeated tappings and prolonged observation are inexcusable in view of the simplicity of exploration.

Once the diagnosis is established, one of two lines of procedure is indicated: either a palliative course of treatment by orchidectomy with radium or X-ray therapy, or an attack, more commensurate with the extreme seriousness of the disease, by radical resection of the growth and its primary lymphatic area. A certain number of cases that come for treatment will have clinical evidence of abdominal metastases. Radical resection should never be attempted in these cases. They are inoperable. Radium packs and X-ray therapy as used by Barringer or Orbaan may check the progress of the malignancy and prolong life. In all other cases, metastases not demonstrable clinically, the attack should be

TABLE V.—ANALYSIS OF CASES OF RADICAL OPERATION—*Continued*

GROUP III.—INCOMPLETE DATA AND MISTAKEN DIAGNOSIS

A—Data Insufficient for Analysis

Author	Date of operation	Age, years	Duration	Side	Clinical metastases	Operation and microscopical diagnosis	Died post-operative	Metastases	Living post-operative	Metastases present
1. Guyot	Not stated. Reported 5-27-21					Radical operation followed by radiotherapy.			Yes	No
2. Patel Case 2		16	5 mos.		None	Radical removal of tumor and regional lymphatics. Diagnosis: sarcoma.				
3. Mauclaire[2] Case 2	1907					Radical operation. Patient very obese.	9 mos.	Both humeri		
4. Pauchet	1910	17	5 mos.		None	Radical operation with removal of glands which were not examined (lost).				
5. Marion Case 2	1920	Young				Radical removal of enlarged lymph glands (ilio-lum.).				
6. Masini	Not stated. Reported 4-4-21					Radical operation. Diagnosis: seminoma.			2 yrs.	No

B—Mistake in Diagnosis

1. Cuneo[1] Case 2	9-9-07	40	1 yr.	R	None	Radical operation—only 1 gland found at operation between aorta and vena cava. Diagnosis: lues.			5 yrs.	
2. Marion[1] Case 1	1910	37			None	Radical operation—no glands were found, and no attempt was made at lymphatic area. Diagnosis: lues.				
3. Mercade[1]	3-14-11	30	5 mos.		None	Radical operation—no glands found. Diagnosis: lues.			Yes	
4. Hinman† Case 6	8 7-20	46	3 mos.	R	None	Radical — numerous enlarged iliolumbar glands removed. On microscopic examination tumor proved to be massive. Tbc. epididymo-orchitis. (Fig. 2 a and b). Glands showed endothelial hyperplasia. Diagnosis: tuberculosis.			2 yrs.	

†Case previously reported.
*Personal communication.
[1]Cited by Mascarenhas.
[2]Cited by Delbet.
[3]Cited by Chevassu.
[4]Cited by Sébileau and Descomps.

SUMMARY OF 79 CASES

Operative deaths	10 (12.6 per cent)
Died of metastases	24
Living with metastases	6
Living and well	34
Killed or lost	2
Incomplete data	3
Total	79[5]

[5]4 cases of mistaken diagnosis not included.

whole-hearted. A certain number of these, unfortunately, will show inoperable masses after retroperitoneal exposure, and will necessarily be condemned to the palliative methods of radium and X-ray. Radiation of the open wound at the operating table is commendable for these as well as for cases of successful resection. In a larger group, which will increase with earlier and more accurate diagnosis, radical surgery is indicated. A small number of these cases might be cured by simple castration, inasmuch as metastases have not yet occurred, but in the interest of the majority they should unhesitatingly be exposed to the risk of a radical operation. This surgical risk is not great, less than 10 per cent, and will undoubtedly diminish as greater knowledge and experience with the operation are obtained.

The technical steps of radical operation for teratoma testis are shown in Figures 5 (frontispiece) and 6. The patient is better turned a little to the opposite side, with a small pad under the back. The cord is exposed through an inguinal incision and clamped so that subsequent pressure and manipulation in delivering the testicle will not spread cells into the blood stream. If upon delivery of the scrotal mass a solid testicular tumor is found, castration should be completed by severing the cord below the clamp with cautery. The tumor mass is immediately sectioned by a pathologist or assistant in order to confirm the diagnosis. Too many radical resections of retroperitoneal glands for tuberculosis or syphilis have been performed (four are reported) to warrant the omission of this necessary diagnostic step. In case of malignancy, the inguinal incision is extended to the twelfth rib, which it then parallels (Fig. 5, *a*). Muscle and fascia are divided in the line of this skin incision down to the peritoneum. Beginning in the iliac fossa (Fig. 5-*d*), the peritoneum is stripped back to and beyond the large abdominal vessels. The ureter and spermatic vessels with lymphatics strip up with the peritoneum, but the lymph nodes remain upon, sometimes being quite adherent, to the vena cava and aorta. Theoretically, the lymph area should be removed from above downward, but practically its clean and complete removal is more difficult in this way than by resection from below, for the reason that traction on the cord greatly facilitates following it and making a clean dissection. It is probable that the cleaner, more complete, removal permitted by dissecting from below upward offsets the theoretical advantage of peripheral attack. It would seem advisable, therefore, to combine the methods by first isolating, ligating and dividing the spermatic vessels at their points of union with vena cava, aorta, or renal vein and then proceeding with resection of the area from below upward.

Occasionaly the glands may be so matted about the inferior mesenteric artery that in order to effect a clean removal, the artery must be sacrificed near its origin. The practicability of this procedure seems feasible on the basis of a series of cats and dogs in which this artery was ligated and cut near its origin without apparently the least untoward effects. This procedure was necessary in one personal case (Hinman Case 7; see Table V), but the patient died of acute cardiac dilatation a few hours after operation so that the efficiency of the collateral circulation in the human could not be determined.

After completion of the resection, immediate exposure on the operating table of the retroperitoneal and iliac area to roentgen radiation is an added protection against recurrence because of possible isolated cells or metastatic areas left behind. The placement of rubber tubes for drainage of the serous discharge, with exit at the back or upper end of the wound, as after kidney operations, is advantageous, and these tubes may be used, or additional ones if desirable, to carry radium for radiation of the resected area for 12 to 14 hours after operation.

SUMMARY

1. Testicular tumors affect all ages, but are most common between 20 and 50. Seminoma rarely occurs in children, while teratoma is relatively common. Duration of these tumors is variable due to the frequency of periods of latency and quiescence in their development. The duration of the growth, or its clinical characteristics furnish no index as to whether or not metastases have occurred.

2. Diagnosis is chiefly a matter of exclusion. The growth may be mistaken for, or masked by, hydrocele. Four cases of radical operation have been performed by mistake on gummata and massive tuberculosis, a fact which emphasizes the importance of careful examination of the tumor before proceeding with the radical dissection.

3. The pathogenesis of testicular tumors has long been a subject for dispute, but for clinical purposes it is convenient to divide them into two groups which occur with about equal frequency, namely, the seminoma and the teratoma. From the statistics on simple castration, teratoma gave a decidedly less favorable prognosis than seminoma. Analysis of cases of radical operation would seem to indicate an equally good prognosis for both groups.

4. Simple castration will cure 15 to 20 per cent of malignant tumors of the testis. Obviously the operation in order to effect a cure must antedate glandular or other metastases.

5. Realization of the inefficacy of simple castration has led to the development of the present radical operation which was made possible through exact knowledge of the primary lymph zones of the testicle, for which we are indebted primarily to Most (1899). This zone occupies the retroperitoneal lumbar area along the aorta and vena cava. The first successful radical operation was performed by Cuneo in France (1906), the patient remaining alive and well 3 years following the radical operation in which a metastatic lumbar gland was removed.

6. Analysis of 79 cases of radical operation shows that 9 cases had palpable metastases at the time of operation. That operation is contra-indicated in this group, is proved by the morbidity of 100 per cent. Thirteen cases revealed inoperable metastatic glands, not palpable clinically, at operation, so that a total of 22 out of 79 cases proved to be primarily inoperable.

7. Another group of 25 cases showed, on subsequent microscopic study, no metastases in the glands removed. Eight of these cases, however, died later of metastases, showing that either the gland area was not completely removed or that metastases were overlooked microscopically in those glands that were removed. Of the 25 cases, 12 remain living and well. Even granting that simple castration would have cured all of these 12 cases, the findings showing that it could have cured none of the others, it could then have cured only about 16 per cent of the entire 79 cases.

8. In still another group of 26 cases the glands removed at operation showed metastases, and all 26 obviously would be doomed by simple castration. Our analysis shows that as a result of the radical operation, however, 17 of these cases are living and well, 4 for over 4 years, and 8 for almost 3 years. It is reasonable to expect a fair proportion of the 17, who have not survived the 4 year time limit, to be cured, since recurrence generally occurs within the first year.

9. X-ray and radium seem to be valuable therapeutic and palliative adjuncts to the treatment of testicular tumors.

CONCLUSIONS

1. Seventy-nine cases of the radical operation for teratoma testis have been collected, either through personal communications, or from the literature. Ten of these comprise personal cases, 5 of which have been previously reported. It is believed that sufficient information is furnished by this material to permit of reliable analysis for comparison with the results following simple castration.

2. Comparison of results of simple castration and radical operation shows, even at this early date for the latter, an improvement in the prognosis of at least 100 per cent, since about 15 per cent of cases are cured by simple castration, whereas at least 30 per cent of the 79 cases analyzed are found to have been cured by the radical operation.

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FRACTURES OF THE ELBOW JOINT AND OF THE LOWER END OF THE HUMERUS[1]

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As structure is subservient to function, it is only natural to presume that the maximum return of usefulness in a limb would be brought about by the exact reconstruction of the deformed bone, but as perfect reduction is not infrequently impossible or inexpedient, our chief aim should always be complete restoration of function.

In the consideration of types of fractures, the line of cleavage is most important. Indirect violence usually gives a spiral or torsion fracture, and there is in most cases little distortion of the limb or injury to the soft tissues. Direct violence usually produces a transverse or comminuted fracture with more deformity and soft tissue injury.

In this paper I shall confine my remarks to fractures of the elbow joint and the lower end of the humerus. My reason for so doing is that even today we see many poor functional results following such injuries. All surgeons of large experience know only too well, and often to their sorrow, that fractures in this region are notoriously liable to lead to suits for malpractice.

Fractures of the Lower End of the Humerus

ANATOMICAL CONSIDERATIONS

Two points in the anatomy of the lower end of the humerus must always be remembered: (1) The inner condyle is placed at a lower level than the outer when the arm is parallel to the erect trunk. By this arrangement the carrying angle is formed, a very necessary position to maintain after injury. (2) The articular surfaces of the humerus are fastened to the shaft of the bone at such an angle (130 degrees) that they point forward and downward instead of directly downward, as is generally supposed. A right angle reduction, therefore, does not bring forward completely the lower fragment or produce a proper tilting angle to the articulation (this explains the rationale of the Jones acute flexion treatment).

How many surgeons take time to visualize accurately the position of the displaced fragments, the aspect of the facets, the angles of obliquity, and the rotatory changes? The roentgen-ray helps us considerably in this. But as my professor of surgery at Johns Hopkins, the late Dr. William S. Halsted, was accustomed to say, "We should be on the alert that we do not allow the roentgen-ray to make us lazy"; and as Sir Robert Jones has declared, "We must beware that we do not paralyze our diagnostic faculties from pure inanition. Roentgen-rays should supplement, not usurp, other means at our disposal." Further, as Jones pointed out in a masterly address delivered before the Wigan Medical Society a few years ago: "It is impossible, in quite a number of cases in young children, despite excellent pictures, to diagnose elbow fractures by means of X-rays, and here our tactile education is invaluable." The reason for this is that the bones in early life are cartilaginous and therefore transparent.

METHODS OF PRODUCTION IN ADULTS AND CHILDREN

Fractures of the humerus in the vicinity of the elbow joint may be caused by direct or indirect violence. If an adult falls on an outstretched arm and sustains a fracture, it is usually a fracture at the base of the radius (often a Colles); if a child, the fracture usually occurs near the elbow. Therefore, the rule can be laid down that a fracture of the elbow in a child is almost always due to indirect violence transmitted through the hand and forearm to the elbow with the arm hyperextended, while the same type of injury in an adult is usually due to violence applied directly to the elbow region.

[1] Read before the Southern Surgical Association, Memphis, Tennessee, December, 1922.

Fig. 1.

Fig. 2.

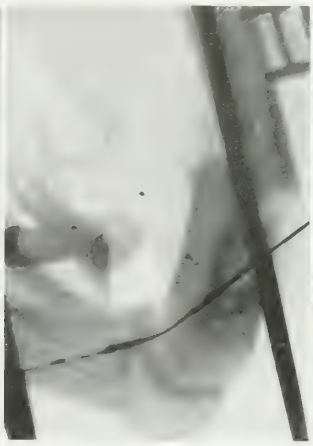

Fig. 3.

Fig. 4.

Fig. 1. Case 1. Anteroposterior view of right elbow. Compound intercondylar T fracture involving joint. Note that the lower end of the humerus is fractured and driven down between the fractured and separated condyles. The proximal end sustained a subcoracoid dislocation.

Fig. 2. Case 1. Lateral view of right elbow. Note that the two lower fragments are projecting anteriorly. Usually these fragments project posteriorly.

Fig. 3. Case 1. Note how traction of pneumatic pad not only pulls down but pushes back lower fragment.

Fig. 4. Case 1. Lateral view of left elbow. Note compound fracture of olecranon process into joint.

If the fracture is in part intra-articular, on account of the intricate formation of the joint, it is very liable to lead to some permanent disability. The lower end of the humerus is structurally weak, due to the existence of various fossæ. If, as is frequently the case, fractures involve the hollows, the latter may become filled with callus. This callus later prevents complete flexion. Usually the fracture line is transverse and not infrequently it is converted into a T or Y shape by a vertical cleft running into the joint. In this way one or both condyles may be misplaced, the capitellum may be divided from the trochlea, or trochlear surface may be split. The deformity may present various conditions, and, as a rule, the lower fragment is carried backward.

VARIETIES OF FRACTURES OF THE LOWER END OF THE HUMERUS

There are actually *ten varieties* of fractures of the lower end of the humerus: (1) supracondylar; (2) diacondylar; (3) intercondylar, T, Y, or atypical; (4) separation of the lower epiphysis; (5) external epicondyle; (6) external condyle; (7) internal epicondyle; (8) internal condyle; (9) capitellum; (10) trochlea.—(Roberts and Kelly.)

1. *Supracondylar fracture.* In this form the line of fracture is usually transverse and just above the tips of the external and internal condyles. It should be distinguished from a low fracture of the shaft and from a diacondylar fracture. In all fractures of the lower end of the humerus, this type will be found in a little over one-third of the cases. This variety of fracture can be grouped into four classes: (a) extension fracture; (b) flexion fracture; (c) abduction fracture, and (d) abduction fracture.

a. In extension fractures the line of fracture runs upward and backward from a point just above the capsule anteriorly and from the external surface inward and upward. This fracture is occasioned by a fall on the outstretched hand with the elbow in hyperextension and abduction. The lower end of the upper fragment is displaced anteriorly by its fellow fragment. The reason this fracture is seen so often in children is that the capsule is stronger than attached bone. If this type is seen in adults, it is due to direct violence.

b. Flexion fractures are very rare. The line of fracture is low posteriorly, running forward and upward. The lower end of the upper fragment is displaced posteriorly.

Fig. 5.

Fig. 6.

Fig. 7.

Fig. 5. Case 1. On account of the dislocation of the shoulder this arm was put in abduction for 2 weeks in a Cleary right angle aeroplane splint with traction on forearm.

Fig. 6. Case 1. Position used at the end of 2 weeks. The flexion of the forearm was increased daily until an acute angle was obtained. Traction is exerted on a pneumatic pad in elbow.

Fig. 7. Case 1. Note sand bags in hand with hot applications on elbow joint. The method used for obtaining extension after joint has been held in acute angle for some time.

c. In the abduction fracture the line is upward and outward.

d. In the adduction fracture the line is just the reverse, that is, upward and inward.

2. *Diacondylar fracture.* Like the supracondylar type this fracture is usually transverse, but is lower, occurring just above the line of the epiphysis, and is partially intra-articular. The line of break is similar to that of the extension variety of the supracondylar type.

3. *Intercondylar, T, Y,* or *atypical fracture.* This fracture usually occurs in adults and is generally due to direct violence, and is frequently compound. The characteristic feature in this fracture is the separation of the condyles from the shaft and from each other. Often there is great displacement of the fragments and considerable traumatism to the surrounding soft tissues.

4. *Separation of the lower epiphysis* is undoubtedly very infrequent. It is observed in childhood up to the fourteenth to the eighteenth year, but usually before the age of 3. The line of separation may be through the epiphyseal cartilage or there may be attached to the epiphyseal cartilage portions of the lower end of the diaphysis. Cohn considers this really a fracture through the cartilage—a condition which might better be called a supracondylar fracture.

5. *Fracture of the external epicondyle* should be mentioned, but is rarely seen. It results from direct violence, the impact being received by the external surface of the lower end of the humerus, or from indirect violence, as when a tear fracture results from hyperadduction of the elbow. With this fracture, posterior dislocation of the radius and ulna may take place.

6. *Fracture of the external condyle.* This type occurs in about 17 per cent of the fractures of the lower end of the humerus and is most frequently seen in children. The line of break often takes a course from the joint obliquely upward and outward, and the detached fragment may consist of a part of the trochlea, the capitellum, and the epicondyle. It may result from a fall directly upon the external

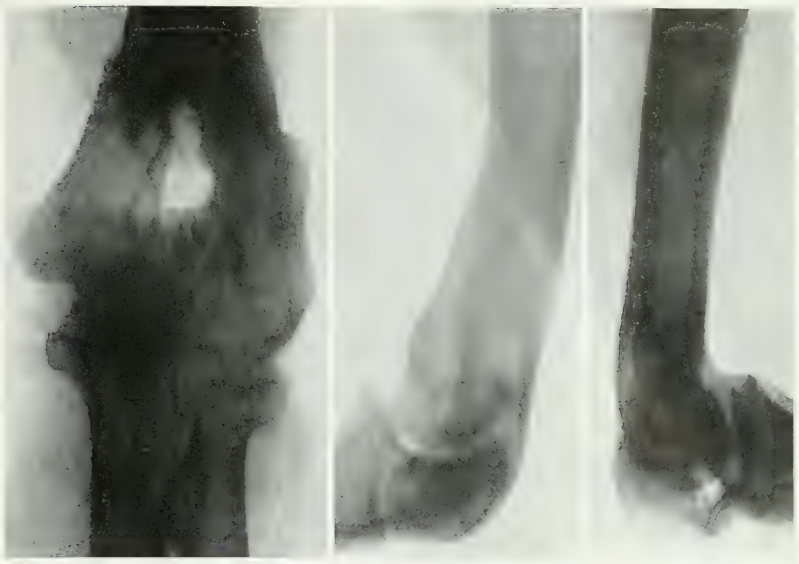

Fig. 8 (at left). Case 1. Anteroposterior view of right elbow 6 months after injury. Note how well the widely separated condyles have attached themselves to the humerus.

Fig. 9. Case 1. Lateral view of right elbow 6 months after injury. Note the perfect anatomical alignment of the two condyles with the main shaft.

Fig. 10. Case 1. Lateral view of left elbow 6 months after injury. Note that while the X-ray does not reveal perfect bony union, the functional result is perfect.

condyle; from a fall upon the hyperflexed elbow, the external condyle receiving the brunt of the impact; by hyperadduction of the elbow (tear fracture); from a fall upon the hand with the arm in full extension, the impact being transmitted through the radius to the capitellum.

7. *Fracture of the internal epicondyle.* In many instances the detached epicondyle is really a separation of the epiphysis. The fusion of the epiphysis with the diaphysis of the humerus occurs about the eighteenth year. Direct violence, such as a fall upon the arm in abduction, may produce the fracture

Fig. 11.

Fig. 11. Case 1. Note that flexion of left elbow is perfect and only slight limitation of right elbow.

Fig. 12.

Fig. 12. Case 1. Note extension of both elbows.

Fig. 13.

Fig. 13. Case 1. Note how patient can use the right elbow for eating and shaving.

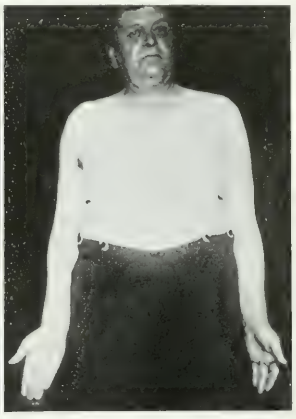

Fig. 14.

Fig. 14. Case 1. Note complete re-establishment of carrying angle.

Fig. 15 (at left). Case 2. Anteroposterior view of severely comminuted fracture of lower end of left humerus. Note the spicules of bone fragments projecting into the soft tissues.

Fig. 16. Case 2. Lateral view. Note anteroposterior separation of lower fragment with the upper shaft in between. The humerus is converted into four large and several small fragments.

Fig. 19 (at left). Case 2. Anteroposterior view 6 months after injury. Note the alignment and attachment of fragments with the main shaft. Note that the sharp spicules of bone as shown in Figure 15 have been completely absorbed or have united with the main shaft.

Fig. 20. Case 2. Lateral view 6 months after injury. Note how the anteroposterior separation has been entirely corrected and the alignment is satisfactory.

or separation. However, the usual cause is hyperabduction of the elbow while in a position of full extension.

8. *Fracture of the internal condyle* is unusually rare. The line runs from the inner

Fig. 17. Case 2. Method of traction on humerus with flexion on elbow. On account of a large wound of the axilla an ambulatory splint was not used.

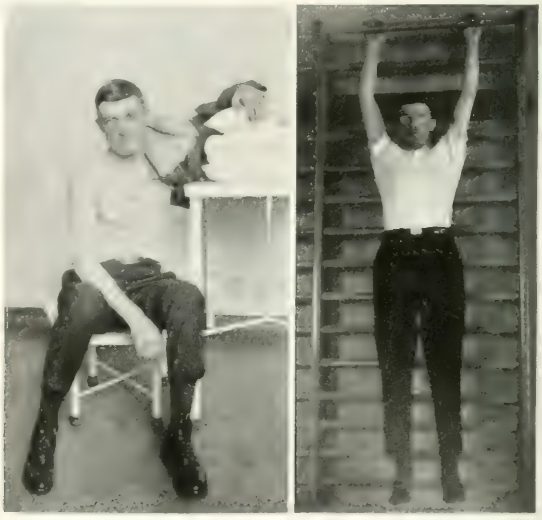

Fig. 18 (at left). Case 2. Abduction of shoulder under heat. Note sand bag on top of large hot compresses overcoming contracture in axillary region.

Fig. 21. Case 2. Exercises on stall bars for stretching scar tissue in old axillary wound.

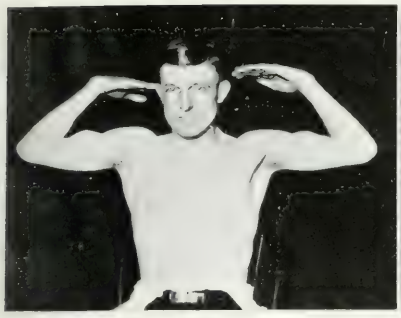

Fig. 22. Case 2. Flexion 6 months after injury.

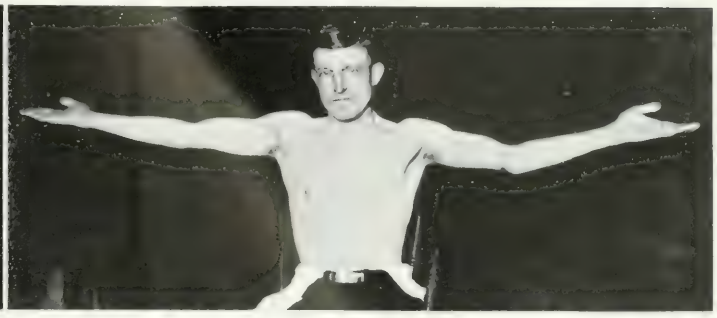

Fig. 23. Case 2. Extension 6 months after injury.

border above the internal epicondyle downward and outward to the trochlear surface. The ulna is attached to the fragment, and both are held in fair position by the radius. If the fragment is displaced upward the carrying angle is diminished.

9, 10. *Fracture of the capitellum and trochlea.* Linden finds that the literature reveals only 17 cases of fracture of the distal articular processes of the humerus; these include fractures of either the capitellum or trochlea, or both. The lesion is a splitting of the articular surface of the bone by a fracture through the cancellous portion, the fragment consisting only of the articular cartilage and a thin strip of underlying bone.

TREATMENT

For the treatment of fractures in the vicinity of the elbow joint, with the exception of fracture of the olecranon process, the fully flexed position offers the best results. Often a splint is unnecessary, the forearm being strapped to the upper arm and fixed to the chest with a bandage. The advantages of the flexed elbow position are:

1. It gives the most complete anatomical reposition of fragments and the best fixation;

2. It favors the retention of the more important flexion function of the joint;

3. It co-operates with gravity in the subsequent restoration of function.

In correcting the initial deformity the following procedures should be carried out:

1. Strong traction is exerted on the forearm with the elbow fully extended and supinated;

2. At the same time the joint is manipulated, the displacement being corrected as far as possible; usually the upper fragment is displaced forward and the lower backward;

3. While maintaining No. 1 and No. 2, the elbow is slowly but firmly flexed to an acute angle and so fixed with the forearm supinated.

As to how long this position of acute flexion should be maintained, of course, will depend somewhat on the case, but usually after about 2 weeks the forearm can be lowered a few degrees every 4 or 5 days. This should be continued until the arm can be fully extended. However, during this process of mobilization,

Fig. 24. Case 3. Note fracture of external condyle with dislocation of forearm.
Fig. 25. Case 3. Six months after injury.
Fig. 26. Case 3. Note perfect extension.
Fig. 27. Case 3. Note perfect flexion.

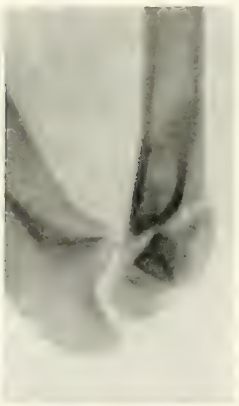

Fig. 28 (at left). Case 4. Oblique supracondylar fracture. Note that the lower fragment is displaced posteriorly, which is most often found and is the reverse of condition shown in Figure 2, Case 1.

Fig. 29. Case 4. Lateral view immediately after reduction. Note complete reposition of fragments and how the position of acute flexion maintains them.

should the elbow stiffen so that the patient cannot obtain the initial degree of flexion, all movement should cease and the arm should again be put in completely flexed position and so maintained for another week. During this time gentle massage can do nothing but good.

Passive movement should begin in the fourth week and should consist of only one movement in each direction (pronation, supination, flexion, and partial extension), and then the arm should be replaced in a sling. As this movement is gently and slowly carried out by the hand, the fracture is protected from strain by the surgeon's other hand. If this passive movement produces much reaction or elicits much pain, it should not be repeated for several days. The joint should be allowed time to recover from the damage. A rebellious reaction following passive movement indicates Nature's plea for more rest and no time is saved by trying to hurry mobilization.

Cohn has pointed out that attention must be directed toward developing the external rotators of the humerus in supracondylar fractures; otherwise patients will continue to carry the arm in the position of internal rotation which will give a cubitus varus of muscular rather than bony origin. In these fractures the position of hyperflexion puts the biceps muscle on the stretch so that it acts as a natural splint.

In fractures of the internal condyle, both pronation and hyperflexion of the forearm are necessary, since muscles are more relaxed in this position and the brachioradialis and supinator brevis tend to diminish the carrying angle. In fractures of the external condyle, pronation would cause the pronator teres to pull the fragment away from the humerus.

Fractures of Upper End of Radius and Ulna

In considering fractures of the elbow joint besides those of the lower end of the humerus, there may be one (1) of the olecranon process, (2) of the coronoid process, or (3) of the head and neck of the radius.

1. *Fracture of the olecranon process* involves the elbow joint and occurs usually at the base or weakest part of the process. It is due to direct injury and is frequent in adult life.

Treatment. Extension of the elbow for 2 or 3 weeks, then begin active movements. At the end of 4 weeks the elbow can be brought to a right angle. Fibrous union with a gap is not frequent enough to warrant an immediate operation; union is nearly always satisfactory.

Whitchurch Howell reports a case in the *Proceedings of the Royal Society of Medicine* of a fracture of the olecranon process, fracture of the coronoid process and a separation of the epiphysis, which he treated in acute flexion in spite of the fracture of the olecranon.

2. *Fracture of the coronoid process* may be due to a backward dislocation of the elbow joint. Its danger is that an obstructive spur may be left in the joint or that a traumatic myositis ossificans may be produced. *Treatment* is by complete flexion.

3. *Fracture of the head or neck of the radius* is not rare. There is no room in this part of the elbow joint for even the slightest displacement or for excess of callus, so that either one may give considerable pain and mechanical disability in the flexion of the elbow and the rotation of the forearm. The fragment is usually displaced outward and forward and may be mistaken for a small piece of the external condyle. The elbow can be almost fully extended and flexed, but supination and pronation are limited.

Treatment. Full flexion for several weeks.

As it is important to limit any excess callus formation, early movement is contra-indicated. If there is actual obstruction to supination, the fractured piece should be immediately excised. In fractures of the elbow joint where sepsis is present, it is often useful to put the supinated arm in full extension and fixation in a Thomas arm-splint until the acute sepsis has been controlled or the fracture has begun to show signs of union. Nearly always, even finely comminuted fractures, in which we know a large part of the fragments are absolutely detached, if not infected, unite very rapidly, forming a large callus. The arm should then be gradually flexed, maintaining the supination. It is unwise to leave the arm extended more than one month for fear of bony ankylosis in this awkward position.

May I be pardoned for saying just a word as to the time for reduction of fractures? As pointed out by Blake, many still think that a fracture can be reduced at any time within the first 10 or 12 days. It is an erroneous and pernicious idea to wait until the swelling subsides. Early reductions often prevent much swelling. Repair does not go on indefinitely; sooner or later it ceases; therefore, it must be conserved and not wasted.

COMPLICATIONS

The possibility of such complications as

1. Volkmann's contracture,
2. Traumatic myositis ossificans,
3. Ulnar nerve or median nerve injury.
4. Permanent restriction of movement from excessive callus formation in the fossæ,

should make the surgeon treating fractures in the vicinity of the elbow joint always on the alert to prevent them.

The possibility of Volkmann's ischæmic paralysis should always be kept in mind, particularly in children. It can be largely prevented by (1) leaving no pad in the elbow, or, if one is necessary, a pneumatic pad, as shown in the photograph; (2) having no constricting band or bandage about the joint; (3) seeing that the angle of flexion is not too extreme.

INDICATIONS FOR OPERATION

Besides (1) removal of the head of the radius, as mentioned above, Stone has called attention to one group of cases requiring open reduction, namely: (2) those in which the epiphysis has been detached and has turned turtle, for replacement by manipulation in such cases is usually impossible; (3) fractured fragments of the capitellum and trochlea should be excised; (4) co-existing nerve injury should be a clear indication for operation. If operation is indicated, it should be done at the earliest possible moment. One should try to be clear in his mind and decisive in his action whether or not he will treat a case by closed or open reduction. Rixford, in his excellent article "On the Mechanics of Production and Treatment of Spiral Fractures," has emphasized that "the open operation should not be relegated to the position of last resort."

Among the French and Belgians, Lambotte is an uncompromising advocate of the open operation, and among the Germans, Bardenheuer takes an extremely conservative position, while Robert Jones, of England, assumes a position between the two. I believe that too many American surgeons are not sufficiently trained in the methods of traction, or have not enough patience in the treatment by closed methods, and, therefore, resort to open operation too frequently. This is due to the fact that fractures in our medical schools are treated often under the head of minor surgery, and are often below the attention of the professor of surgery, who confines himself largely to the more dramatic anatomical area, the abdomen.

We should never lose sight of the fact that some of the ugliest and anatomically poorest appearing elbows may possess remarkable movement, while many elegantly shaped joints may be practically devoid of it. This should be clearly explained to the patient by the surgeon to avoid criticism later. It should also make us think twice before we operate and introduce screws, silver wire, bands, and Lane plates.

The ultimate attainable aim in the treatment of fractures of the elbow joint must be the formation of a normal joint. If, when the fracture is healed, the range of motion is sufficient to bring the hand to the mouth in flexion and to place it in the trousers' pocket

in extension, the result is considered satisfactory.

In conclusion, by way of emphasis, I wish to state that only recently I was called in consultation to see a young woman who had sustained, a year or two previously, a comminuted fracture of the lower third of the humerus, not as severe as shown on the accompanying photograph. No attempt was made to reduce the fragments by traction and flexion. An open operation was performed and a band applied. This became loose afterward and a second operation was performed and a Lane plate inserted. A third operation followed, and this time silver wire was the metal of choice. Sepsis occurred and the wound did not heal for months. When I saw the case the greater part of the lower third of the humerus had been destroyed and the girl's chance of having a normal arm was gone forever. Bone grafting offered the only chance of securing for her an arm at all. This is just one of many cases, such as all of you have seen. But should not such cases make us stop and think what we can do to prevent, as far as possible, the ruthless open operation on fractures? We hear a great deal among the internists about preventive medicine; should we not hear more among surgeons about preventive surgery, especially in the treatment of fractures?

Case 1. *Compound intercondylar T fracture involving joint.* This fracture is exceedingly interesting. It occurred in a man, age 58, weighing 220 pounds, who was hurled 15 feet from a revolving wheel. He sustained seven fractures, three of them compound, and two dislocations. The right arm, shown in Figure 1, evidently received more than its share of the impact, as he sustained a transverse fracture of the lower third of the humerus with a splitting fracture extending down into the joint, converting it into a complete compound intercondylar T fracture and separating the condyles widely. The head of the humerus on the same side was dislocated. When the condyles are so widely rent asunder we can be absolutely certain the two lateral ligaments have been extensively ruptured. In this case the shaft was, as it were, driven down between the separated condyles.

The problem which presented itself in this right arm alone was the reduction and treatment of the dislocated shoulder, the reduction and treatment of the compound intercondylar T fracture of the elbow joint and the prevention of sepsis to the joint. The arm was put in a right angle abduction aeroplane splint with traction on the forearm for 2 weeks. During this time, as you will see from Figure 3, the forearm was in pronation. The wounds were treated with dichloramine-T. The arm was then taken down and put in a Jones right angle splint. The problem then was to bring about four things, namely: (1) to still further correct the shortening; (2) to push the upper fragment forward and the lower fragment backward; (3) to obtain as quickly and as completely as possible the angle of acute flexion; and (4) to secure complete supination of the forearm. The accompanying photographs tell the story of how this was accomplished.

This man made practically a complete recovery and was back at work in less than a year from the date of injury. The only residue which remained of his multiple fractures was a slight limitation of flexion and extension of his right elbow. This, as you see by the photographs, was so slight that he can easily flex his arm to eat or shave, and readily put his hand in his trousers' pocket.

Case 2. *Severely comminuted fracture of the lower third of humerus.* This occurred in a man, age 30, and was the result of a heavy log rolling over his arm. The humerus, as you will see, was broken into six fragments, with several small spicules projecting out into the muscles. This fracture was complicated by a large infected wound of the axilla of the same side. The accompanying photographs show that this arm was treated by flexion and traction with practically a 100 per cent recovery of all movements (Figs. 15 to 23). The mistake is often made in this type of fracture of applying metal bands or silver wire. Traction makes the biceps and triceps muscles natural splints which mold these fragments together. The small spicules of bone in the muscles should cause us no alarm, as they are later absorbed.

Case 3. *Fracture of the external condyle with dislocation of the forearm.* This occurred in a child of 2 years who was seen immediately after injury. Supination, traction, and flexion of the forearm gave a complete reduction with a perfect ultimate recovery, as shown in Figures 24 to 27.

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ACUTE (PUERPERAL) INVERSION OF THE UTERUS

With Report of Two Cases

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INVERSION of the uterus (puerperal) is very rare. I quote the following statistics:

W. Nacke, Leipsig, 1916, says 1 case in 10,000; H. Riddlinger, Leipzig, says that from 1878 to 1919 they had 6 cases in 67,091 births, or 1 in 12,000; E. E. Welponer, Triest, 1918, says from 1885 to 1914, there were no cases in the clinic in 1,302 deliveries, but he had records of 5 cases that occurred in the city; Ahlfeld, Leipzig, reports it as occurring once in 100,000 cases; Zangemeiski says 1 in 400,000 cases; von Brun in Vienna Clinic, says there were no cases in 250,000 births; Kehrer saw 1 case in 2,000 births.

Other writers report it as exceedingly rare. The average was given by Jones as 1 in 128,767 labors.

The case forming the basis of this paper is briefly as follows:

Mrs. S., age 23, primipara, delivered noon September 26. Normal delivery; placenta delivered manually within a very short time. (May say that the accoucher had acute suppurative otitis media at the time.) Patient seemed well for 4 hours, when the untrained woman in attendance noticed some blood clots and a large mass between her thighs. No attention was given to this until 4 o'clock the next morning (12 hours later), when a trained nurse was called and noticed this condition and immediately called the medical attendant, who cleaned away the blood and pushed the mass back into the vagina; said he did not know what was wrong, and a consultant was called, who sent patient to the hospital where she arrived 28 hours after probable time of inversion.

On entrance patient was pale, weak, pulse 120, temperature 100 (rectal), blood hæmoglobin 62 per cent, red blood cells 2,790,000, white cells 23,800. The uterine body could not be felt in the abdomen. A large mass was felt filling the vagina, evidently the inverted uterus.

Operation. Gas-oxygen-ether anæsthesia; on examining the mass in the vagina much blood was wiped away from about it, and the raw surface of the placental site was on the fundus. The abdomen was opened through a small incision, the cervix dilated by the operator first inserting his index fingers and then an assistant doing the same, thus with the four fingers stretching the cervix. A second assistant with his hand in the vagina rather easily re-inverted the uterus. It was interesting to note how the re-inversion occurred, beginning first on the posterior wall near the cervix and gradually rolling in until there was full reposition. The uterus then looked perfectly normal, as did the tubes and ovaries. The patient continued to have the same temperature, about, as she entered with from September 27 to October 9. She was feeling very well and nursing her child.

October 9, she had a chill followed by temperature of 103°. Examination of the abdominal wound and the pelvis showed no apparent cause for the fever and inasmuch as the patient had a painful infected tooth, we suspected that this might be the cause of the fever and had it pulled.

For the next 5 days patient felt better and nursed her child up to October 16, when she had a temperature of 104.6° and from this date until October 31 patient continued with a high fever and was exceedingly ill, and developed a severe phlebitis of the left leg, and later a slight phlebitis in the right leg. During this time, involution was taking place. There was no tenderness in the abdomen, the lochia was foul at no time, and the only pelvic finding was some tenderness and infiltration on the left side, when the phlebitis was at its height.

On November 23 phlebitis had cleared up nicely, and patient had been sitting up a few days when she developed a severe pain in the right hip joint. After a few days' observation a Buck's extension was put on the right leg and very shortly the pain and tenderness disappeared. At this time (December 6), there was considerable enlargement of the spleen, but the uterus was well involuted, in good position, movable, and there was no pelvic infiltration.

December 15, patient discharged, feeling well, there is no swelling of the limbs, no tenderness in the right hip, pelvis is normal on examination, splenic enlargement has disappeared, blood examination is as follows: hæmoglobin 58 per cent, red blood cells 2,540,000, white blood cells 8,800.

The second case I saw several years ago, and reposition had been effected by the nurse before my arrival at hospital, the doctor in the meantime standing by non-plussed and helpless.

The literature on inversion is as voluminous as the condition seems rare. Dr Peterson, of Ann Arbor, in Surgery, Gynecology

AND OBSTETRICS, 1907, wrote an extensive paper on chronic inversion and his bibliography includes 84 references.

In 1913 W. C. Jones, of Chicago, published a paper in SURGERY, GYNECOLOGY AND OBSTETRICS, in which he detailed a very interesting case, reviewed the literature very thoroughly, and his bibliography includes 250 references, many of them, however, the same as Peterson's. He gives credit to W. Thorn, Germany, for the best analysis of the subject in a series of papers in German literature from 1898 to 1912.

I have been able to collect reports of 61 cases of acute puerperal inversion since 1913, but feel sure that the bibliography is far from complete.

Much has been written about how inversion occurs, but that relaxation of the uterus from any cause, especially a long tedious labor or sudden profuse hæmorrhages, is the prime predisposing cause, seems certain.

Improper delivery of the placenta either by expression on the fundus or traction on the cord seems to be in many, if not most, cases the direct cause of inversion. However, a very considerable number of cases of inversion where such methods were not used, where the placenta was delivered spontaneously or where the inversion occurred with the placenta still adherent (18 of the 61 cases) proves that neither expression nor traction is necessarily a factor in its occurrence.

Where inversion occurs with the placenta attached, it is interesting to note that this attachment is most frequently fundal. Since the uterine wall is thinner and weaker at the placental attachment, if this attachment is fundal the most favorable condition occurs for inversion, which probably always begins by dimpling or indentation at or near the fundus. If this is true, the rarity of fundal attachment of the placenta as noted by E. Bumm, 1908, quoted by Huntington in *Boston Medical and Surgical Journal*, 1921, would account for the rarity of inversion.

Following is shown an analysis of the 61 cases of acute puerperal inversion which I have been able to find since the publication of Jones' paper in 1913.

CASE 1. Reported by M. B. De Bangra, An. Fac. de Med., 1920. No details given as to delivery of child. Posterior hysterotomy done; result not stated.

CASE 2. Reported by J. Barris and M. Donaldson, Proc. Roy. Soc. Med., London, 1920. Patient III-para. Delivery normal, Credé with traction on cord, unattached placenta. Aveling's repositor used in seventh week; patient recovered.

CASE 3. Reported by G. M. Boyd, Am. J. Obst., 1920. Patient III-para. Child delivered by forceps; manual extraction of attached placenta. Seven hours later abdominal section done; patient recovered.

CASE 4. Reported by J. P. Cohen, Boston M. & S. J., 1922. Patient I-para. Child delivered by forceps, Credé method, placenta attached. Abdominal section 9 hours later; patient recovered.

CASE 5. Reported by C. Culbertson, Surg. Gynec. & Obst., 1920. Patient I-para. Forceps delivery, manual extraction of unattached placenta. Posterior colpohysterotomy; patient died.

CASE 6. Reported by O. T. Dinnik, Proc. Roy. Soc. Med., London, 1917. Patient I-para. Delivery normal; manual extraction of attached placenta in 24 hours. Total hysterectomy; result not reported.

CASE 7. Reported by F. Engelman, Zentralbl. f. Gynaek., 1920. Patient multipara. Delivery normal, Credé extraction of unattached placenta. Immediate manual reposition; patient recovered.

CASE 8. Reported by Quante, Zentralbl. f. Gynaek., 1920. Patient I-para. Delivery normal, Credé extraction of unattached placenta; patient died 24 hours later.

CASE 9. Reported by W. G. Evans, Lancet, Lond., 1920. Patient I-para. Delivery normal, spontaneous expulsion of unattached placenta. Immediate manual reposition; patient recovered.

CASE 10. Reported by Gascon, Rev. de clin. et de therap., 1921. Patient I-para. Delivery normal; spontaneous expulsion of unattached placenta. Manual reposition in 3 minutes; phlebitis; patient recovered.

CASE 11. Reported by J. M. Griffin, Am. J. Obst., N. Y., 1917. Patient I-para. Child delivered by forceps; Credé extraction of attached placenta with traction on cord. Immediate reposition by taxis; phlebitis. Patient recovered.

CASE 12. Reported by F. Campbell, J. Am. M. Ass., 1921. Patient I-para. Delivery normal; normal extraction of unattached placenta. Inversion on seventeenth day, immediate manual reposition. Patient recovered.

CASE 13. Reported by J. Huntington, Boston M. & S. J., 1921. Patient III-para. Child delivered by forceps. Normal extraction of unattached placenta. Abdominal section; patient recovered.

CASE 14. Reported by J. Huntington, Boston M. & S. J., 1921. Patient I-para. Normal delivery, incomplete extraction of attached placenta. Hysterectomy on fifth day; on sixteenth day patient died.

CASE 15. Reported by G. Iurcev, Wien. klin. Wchnschr., 1918. Patient II-para. Delivery normal; traction on cord, placenta unattached. Manual reposition; patient died in 2 hours.

CASE 16. Reported by G. Iurcev, Wien. klin. Wchnschr., 1918. Patient multipara. Delivery normal, normal extraction of unattached placenta. Patient died before reposition was attempted.

CASE 17. Reported by G. Iurcev, Wien. klin. Wchnschr., 1918. Patient multipara. No details as to delivery of child or extraction of placenta given. Hysterectomy done on third day; patient died.

CASE 18. Reported by G. Iurcev, Wien. klin. Wchnschr., 1918. Delivery normal, extraction of unattached placenta normal. Manual reposition on third day. Recovery.

Case 19. Reported by G. Iurcev, Wien. klin. Wchnschr., 1918. Patient I-para. Delivery of child normal, normal extraction of unattached placenta. Vaginal hysterectomy in third week; patient recovered.

Case 20. Reported by G. Iurcev, Wien. klin. Wchnschr., 1918. Delivery normal; normal extraction of unattached placenta. Anterior colpotomy done. Patient recovered.

Case 21. Reported by von Jaschke, Deutsche med. Wchnschr., 1919. Patient multipara. Delivery normal. Credé extraction of unattached placenta with traction on cord. Immediate manual reposition. Patient recovered.

Case 22. Reported by W. L. Knipe, Am. J. Obst., 1917. Normal delivery of child. Attached placenta peeled off. Immediate manual reposition. Patient recovered.

Case 23. Reported by J. A. Maclay, J. M. Ass. New Jersey, 1918. Patient I-para. Delivery spontaneous; spontaneous extraction of unattached placenta. Reposition partially spontaneous, partially manual. Patient recovered.

Case 24. Reported by R. A. Malcolm, M. J. Australia, 1917. Patient multipara. Delivery normal; spontaneous extraction of unattached placenta. Reposition not attempted. Patient died in 3 minutes.

Case 25. Reported by W. P. Manton, M. J. New York, 1921. Patient multipara. Delivery normal, Credé extraction of placenta with force. Immediate manual reposition. Patient recovered.

Case 26. Reported by W. P. Manton, M. J. New York, 1921. Patient I-para. Child delivered by forceps; spontaneous delivery of unattached placenta. Manual reposition second day. Patient recovered.

Case 27. Reported by T. Micholitsch, Zentralbl. f. Gynaek., 1920. Patient I-para. Delivery by forceps. Attached placenta adherent. Immediate manual reposition. Patient recovered.

Case 28. Reported by W. Nacke, Zentralbl. f. Gynaek., 1919. Patient II-para. Delivery normal; attached placenta adherent. Posterior hysterectomy done; patient recovered.

Case 29. Reported by G. Shoemaker, Am. J. Obst., 1917. Patient III-para. Delivery normal; normal extraction of unattached placenta. Spinelli operation done; patient recovered.

Case 30. Reported by H. R. Spencer, Proc. Roy. Soc. Med., Lond., 1919. Patient XII-para. Delivery unassisted. Attached placenta adherent 19 days. Spontaneous reposition on forty-first day. Patient recovered.

Case 31. Reported by H. R. Spencer, Proc. Roy. Soc. Med., Lond., 1919. Patient multipara. Delivery spontaneous. Normal extraction of unattached placenta. Aveling's repositor used for ¾ hour on eleventh day. Patient recovered.

Case 32. Reported by H. R. Spencer, Proc. Roy. Soc. Med., Lond., 1919. Patient I-para. Spontaneous delivery, normal extraction of unattached placenta. Aveling's repositor used for 5½ hours on twenty-second day. Patient recovered.

Case 33. Reported by H. R. Spencer, Proc. Roy. Soc. Med., Lond., 1919. Patient multipara. Spontaneous delivery, normal extraction of unattached placenta. Aveling's repositor used 2 years, 8 months later. Recovery.

Case 34. Reported by H. R. Spencer, Proc. Roy. Soc. Med., Lond., 1919. Spontaneous delivery of child, normal delivery of unattached placenta. Aveling's repositor used 7½ hours after 9 months. Patient recovered.

Case 35. Reported by M. A. Swiney, J. M. Ass. New Jersey, 1922. Patient I-para. Delivery by forceps. Normal extraction of unattached placenta. Immediate manual reposition. Patient recovered.

Case 36. Reported by Townesend-Whitling, Lancet, Lond., 1920. Patient I-para. Normal delivery; spontaneous extraction of unattached placenta. Immediate manual reposition; patient recovered.

Case 37. Reported by A. von Valenta, Gynaek., Berl. u. Wien., 1917. Normal delivery; traction on cord, placenta attached. Hysterectomy done; patient recovered.

Case 38. Reported by J. A. Watson, Brit. M. J., 1919. Normal delivery; normal extraction of unattached placenta. Immediate manual reposition; patient recovered.

Case 39. Reported by R. Worrall, M. J. Australia, 1922. Patient I-para. Normal delivery, normal extraction of unattached placenta. Reposition not attempted; immediate death.

Case 40. Reported by R. Worrall, M. J. Australia, 1922. Patient multipara. Normal delivery, normal extraction of unattached placenta. Manual reduction; patient recovered.

Case 41. Reported by R. Worrall, M. J. Australia, 1922. Patient I-para. Delivery of child with forceps. Credé extraction of attached placenta. Piccoli's operation done, patient recovered.

Case 42. Reported by H. W. Yates, J. Michigan M. Soc., 1920. Normal delivery; Credé extraction of attached placenta and traction on cord. Manual reposition after 20 hours. Patient recovered.

Case 43. Reported by W. G. Williams, Brit. M. J., 1915. Patient III-para. Normal delivery; normal extraction of unattached placenta. Uterus ruptured from vagina and expelled. Patient died.

Case 44. Reported by Peter Stewart, Brit. M. J., 1916. Patient I-para. Delivery with forceps; normal extraction of unattached placenta. Manual reduction 8 hours. Patient recovered.

Case 45. Reported by F. L. Pochin, Brit. M. J., 1915. No details of delivery were given. Manual reduction. Patient recovered.

Case 46. Reported by James Oag, Brit. M. J., 1915. Patient II-para. Normal delivery; attached placenta adherent. Manual reposition after 1 hour. Patient recovered.

Case 47. Reported by C. G. Kurien, Brit. M. J., 1915. Patient I-para. Delivery of fetus and placenta intact; placenta unattached. Manual reduction in 15 hours; patient recovered.

Case 48. Reported by E. Holland, Brit. M. J., 1915. Delivery normal; attached placenta adherent. Immediate manual reposition. Patient recovered.

Case 49. Reported by M. Pasman, Semana méd., 1921. Patient II-para. Delivery spontaneous; spontaneous expulsion of unattached placenta. Vaginal hysterectomy done. Patient died.

Case 50. Reported by J. H. Hobbing, Brit. M. J., 1915. Normal delivery; no details given as to placenta. Immediate manual reposition. Patient recovered.

Case 51. Reported by D. J. McAfee, Brit. M. J., 1913. Patient V-para. Delivery normal; placenta expressed; immediate reposition by taxis. Patient recovered.

Case 52. Reported by J. Edge, Brit. M. J., 1914. No details given of delivery and placenta. Reduction on third day; patient recovered.

Case 53. Reported by C. Carruthers, Brit. M. J., 1915. Patient II-para. Delivery with forceps; attached placenta adherent. Immediate manual reposition. Patient recovered.

Case 54. Reported by C. Carruthers, Brit. M. J., 1915. Patient III-para. Delivery normal; attached placenta adherent. Manual reduction same patient as above. Patient recovered.

Case 55. Reported by E. Evans, Western Surg. Conf., 1922. Normal delivery; manual extraction of placenta. Laparotomy done. Patient recovered.

Case 56. Reported by E. Evans, Western Surg. Conf., 1922. Normal delivery; manual extraction of placenta. Immediate manual reposition. Patient recovered.

Case 57. Reported by James P. Aylen, Fargo, N. D. Personal communication. Mrs. L. C., age 25, I-para. Normal labor December, 1912. Severe hæmorrhage, uterine inversion. Operated upon February 25, 1913, reduction after laparotomy. Patient died February 25, 1913, of shock.

Case 58. Reported by James P. Aylen, Fargo, N. D. Personal communication. Patient age 17, I-para, December 5, 1915, in hospital. One week after going home felt mass in vagina which soon protruded. Operated December 29, abdominal incision. Patient recovered.

Case 59. Reported by James P. Aylen, Fargo, N. D. Personal communication. Mrs. R. G., age 29, I-para; delivery November 6, 1920. November 7 severe bearing down pains, extrusion of inverted uterus. Great shock. Replacement by taxis. Died 1 hour later.

Case 60. Reported by George Gay, Richmond, Virginia. Personal communication. Patient 30 years of age. Precipitate labor. Complete inversion. Placenta immediately removed, uterus replaced manually. Patient recovered.

Case 61. Reported by George Gay, Richmond, Virginia. Personal communication. French poodle dog, delivered of two puppies. Severe bleeding, complete inversion of uterus, placenta attached. Placenta removed and uterus reinverted. Dog recovered.

The method of treatment used and the results obtained in these 61 cases are as follows (so far as given in reports):

	Cases	Deaths
Abdominal laparotomy	6	1
Vaginal hysterectomy	5	4
Anterior colpohysterotomy	3	0
Posterior colpohysterotomy	3	0
Manual reposition	31	5
Aveling's repositor	5	0
Spontaneous reduction	2	0

Somewhat peculiar and sometimes startling methods have been used for reposition. Aveling's repositor, with variously modified cups to fit the fundus of the inverted uterus, or perhaps to fit the ill-conceived mechanical conception of the operator, has been used quite often. A potato masher and an ebony ruler have been used. A noted gynecologist in the late years of the nineteenth century used elastic compression to reduce the size of the uterus with resulting necrosis requiring vaginal hysterectomy.

One of the surprising things is the number of cases that spontaneously re-invert, not infrequently while the attendant is waiting for a favorable condition to attempt reposition.

That tragedies have occurred in connection with this fortunately rare condition (mentioned by Hippocrates and doubtless occurring eons before his time) may be gathered from the following unique cases.

Case 1. E. H. Smith, *British Medical Journal*, 1807, was called by midwife, who had found a mass between the thighs of the patient and believing this to be the placenta, had pulled on the inverted uterus for three quarters of an hour until the uterus, one tube, and one ovary came away. On examination he found the other tube and ovary congenitally absent. He closed the peritoneal cavity and repaired the vagina, and the patient made a complete recovery.

Case 2. Dr. N. G. Williams, *British Medical Journal*, 1915, gives the following case: III-para delivered by midwife, at 6:30; placenta expelled normally. At 7:15 midwife saw what she thought was a second child and sent for the doctor, who arrived at 7:30. He was shown two basins, the placenta in one and the contracted uterus in the other, which had separated at the cervix. The woman died soon after his arrival.

Case 3. Dr. W. C. Jones, Chicago, Surgery, Gynecology and Obstetrics, June 30, 1913, reports the case of a woman who, in her ninth pregnancy, had a normal labor and puerperium up to the tenth day. On the fourteenth day she had severe pains; the doctor (not Jones) found inverted uterus in the vagina. On the seventeenth day he took her to the hospital; and on the eighteenth day the doctor (not Jones) amputated the mass in the vagina as high in the vaginal vault as possible. There was some prolapse of the omentum which he corrected and the patient was put to bed. On July 30, Dr. Jones was called and found pelvic infection and did a laparotomy and removed the right tube and both ovaries, and evacuated 3 ounces of pus and used both abdominal and vaginal drains. The left tube had been removed at previous operation, and examination of the specimen showed it to be the inverted uterus with a fibroid attached to its fundus.

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Dr. W. C. Jones, Chicago, in 1913, published a paper in Surgery, Gynecology and Obstetrics in which he detailed an interesting case and reviewed the literature very thoroughly. His bibliography includes 250 references, some of which are duplicates of Peterson's.

CHEMICAL CHANGES IN THE BLOOD OF MAN AFTER ACUTE INTESTINAL OBSTRUCTION

An Indication for Treatment with Sodium Chloride

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In a recent publication (1) we have called attention to transitory reactions following gastro-enterostomy which were associated with a rise in the non-protein nitrogen of the blood, a rise in the carbon dioxide combining power of the plasma, and a fall in the blood chlorides. The urine showed an increase in the non-protein nitrogen and a marked diminution in the chloride excretion. We have interpreted these changes as due to an intoxication caused by a temporary obstruction, or partial obstruction of the duodenum, probably at the gastro-enterostomy stoma.

SUMMARY OF EXPERIMENTAL STUDIES

The increase in non-protein nitrogen in the blood of animals with experimental intestinal obstruction was first observed by Tileston and Comfort (2) and later by Whipple (3) and his co-workers. We have studied the blood and urine of dogs with both pyloric (4) and small bowel obstructions (5).

Dogs which were afflicted with untreated pyloric or duodenal obstruction died, on an average, in 4 days. They all showed a fall in the chlorides of the blood usually with a coincident rise in the carbon dioxide combining power followed by a marked rise in the non-protein nitrogen. In the urine of these dogs was found a high level of non-protein nitrogen and an almost total absence of chlorides.

Dogs with pyloric obstruction treated with 50 cubic centimeters of 10 per cent sodium chloride solution daily, beginning at the time of operation, did not show the blood changes noted above. Other dogs with obstruction of the duodenum for 48 hours, showing typical blood changes and treated with 50 cubic centimeters of 10 per cent sodium chloride daily, showed a rapid return of blood to normal. The strong solution of sodium chloride was used to eliminate the question of liquid as a factor in the change in the blood.

Dogs with pyloric obstructions showing marked blood changes, as has been stated, got entirely well after release of the obstruction in 48 hours and subsequent treatment with 10 per cent sodium chloride. Dogs treated with 25 per cent glucose or plain water developed the changes as rapidly as those having no treatment. Dogs in which pyloric obstruc-

TABLE I

Case	Day of examination	Blood (mgms. per 100 cm.)						Urine (mgms. per 100 cm.)	
		Non-protein nitrogen	Urea nitrogen	Chlorides	CO^2 combining power	Uric acid	Creatinine	Non-protein nitrogen	Chlorides
	Normal (Hosp. diet)	25–35	10–15	450–550	50–75	1–4	1.2	5.12	5–10
1.	Day of operation	104.0	37.8	410	36.2	3.8	2.0		
	Day after operation 2.	57.5	27.9	410	75.9	5.9	1.6		
	3	60.0	18.8	340	80.6	6.7	1.6	(3.5%)	(.05%)
	4	50.0		380		3.8	1.3		
	5	32.7	8.4				1.0	(2.2%)	(.06%)
	7	45.6	11.0		80.6	3.2	1.7		
	9	54.6	20.1	440	57.9	2.8	1.7		
	10.							3.3	.62
	11.							5.5	2.5
	12.							4.6	2.4
	13							5.0	6.1
	14.							7.3	6.6
2	Day before operation 1	107.0		400	34.7		2.5		
	2	107.5	45.5	500	41.0	3.0	2.1		
	Day of operation 0	62.0	32.2	500	43.9	1.9	1.6	23.8	1.8
	Day after operation 1	55.0	28.0	440	40.3	1.2	1.8	7.0	2.3
	2	68.0	34.9	580	46.7	1.4	1.6		
	3	79.8	38.5	570	48.6	1.4	1.8	24.4	4.1
	4	75.0	35.2	460	34.7	1.4	1.8	9.2	2.9
	5	111.0	56.7	320	42.8	2.4	1.8	9.3	0.7
	6							6.6	0.2
	7	61.5	32.6	380	41.9	2.2	1.5	8.8	0.7
	8	61.5	34.0	490	31.9	2.7		9.4	5.5
	9							6.3	1.0
	10	58.8	37.3	450	38.1	3.8	1.7	9.6	0.5
	11							12.7	0.5
	12							12.0	0.3
	13							2.1	0.15
	14							1.2	0.06
3.	Single examination		20.5	410	47.5		1.5		(0.07%)
4.	Single examination	57.8	28.5	370	38.1		1.5		

tion was released and which had no further treatment, showed a continuation of the high non-protein nitrogen in the blood, indicating that the toxæmia was still present even several days after the obstruction had been removed.

Two dogs in which the duodenum was sectioned and the cut ends inverted were given 500 cubic centimeters of 0.85 per cent sodium chloride subcutaneously on the day of operation and each day thereafter until death. One dog lived 21 days and the other 28 days. A marked alkalosis was present in each, but there was no rise of non-protein nitrogen in the blood or fall in the chlorides. Dogs treated daily with like quantities of plain water, 2 per cent glucose solution and 1 per cent sodium bicarbonate, all showed the blood changes of untreated duodenal obstruction and died in 1 to 9 days after operation. Hartwell and Houget (6) in 1912 kept dogs with duodenal obstruction alive for three weeks with physiological saline solution. They attributed death in intestinal obstruction to dehydration of the tissues and concluded that their dogs were kept alive by the administration of water. We believe that we have definitely proven the sodium chloride to be the chief factor in combating the toxæmia in these cases.

The following brief case reports are presented to show the blood changes after intestinal obstruction in man and, in one case, to show the effect of the administration of sodium chloride upon the blood findings.

Case 1. M. K., a housewife, age 36, was admitted to the Surgical Service of Dr. M. T. Sudler, Bell Memorial Hospital, June 20, 1922, with a typical history of intestinal obstruction lasting 40 hours. At operation an obstruction due to an enterolith was found in the ileum about 3 feet from the cæcum. The gut above the obstruction appeared completely paralyzed. The blood showed a rise in non-protein nitrogen to 104 milligrams per 100 cubic centimeters, urea nitrogen 37.3 milligrams per 100 cubic centimeters, carbon dioxide combining power of the plasma 36.2 volume per cent and a chloride of 410 milligrams per 100 cubic centimeters. During

the next 4 days the chlorides dropped to 340 and the carbon dioxide combining power rose to 80.6. During this time 3,000 cubic centimeters of physiological saline solution were given by hypodermoclysis. On the fourth day after operation the urine contained 0.05 per cent of chloride. Even after the obstruction was relieved and the patient well on the road to recovery, the non-protein nitrogen and carbon dioxide remained higher and the chlorides lower than normal, showing the slowness with which the body tissues regain their chemical equilibrium. (See table, Case 1.)

Case 2. A. J., a laborer, age 50, was admitted to the Bell Memorial Hospital, with a history of intestinal obstruction for 5 days. The general condition of the patient was so serious that operation was temporarily postponed. The blood showed 107 milligrams of non-protein nitrogen per 100 cubic centimeters, carbon dioxide combining power of plasma of 34.7 volume per cent and chlorides 400 milligrams per 100 cubic centimeters. The day after admission an enterostomy was done which did not drain and another was done the following day. During the first 36 hours of the patient's stay in the hospital, 90 grams of sodium chloride were given him by hypodermoclysis in a 3 per cent solution with but 1.8 grams appearing in the urine. At the end of this time the blood chloride had risen to 500 milligrams per 100 cubic centimeters, the carbon dioxide combining power to 43.9 and the non-protein nitrogen had dropped to 62 milligrams per 100 cubic centimeters. After the fifth day the chlorides dropped below normal and remained below that level until death. An average of 1,000 cubic centimeters of physiological saline was given daily after the fifth day which was not sufficient to maintain the chlorides at a normal level. The chloride excretion continued very low. On about the fifth day after operation the patient developed a peritonitis due to a leakage from the first enterostomy which resulted in his death at the end of 15 days.

Case 3. H. Y., a school boy, age 17, was seen in consultation at National Military Home, Kansas. He had a typical intestinal obstruction of the lower ileum following a suppurative appendicitis 6 weeks before. Blood for a single examination was taken 36 hours after the first symptoms of abdominal pain before distention had become marked. The urea nitrogen was 20.5 milligrams per 100 cubic centimeters, the chlorides 410 and the carbon dioxide combining power of the plasma 47.5 volume per cent. A specimen of urine taken at the same time showed only 0.07 per cent of chlorides. The patient died following an operation for relief of the obstruction.

Case 4. E. D., age 26, was operated upon at the U. S. Veterans' Hospital, Kansas City, Missouri, February 2, 1923, and a volvulus 20 centimeters in length found about 8 centimeters from the ileocæcal valve. The duration was 30 hours. Fifteen hours after operation blood was taken for a single chemical analysis. It showed a non-protein nitrogen of 57.8 milligrams per 100 cubic centimeters, chlorides of 370 and carbon dioxide combining power of 38.1. Up to this time no sodium chloride had been given except a small quanity of physiological saline by rectum. This patient recovered.

The clinical cases of acute intestinal obstruction reported show a definite and constant change in the blood chemistry by a fall in the blood chlorides with a frequent coincident rise in the carbon dioxide combining power of the plasma and a rise in the non-protein nitrogen and urea nitrogen of the blood. The urine has an increased non-protein nitrogen content and a great reduction in total chlorides.

These chemical changes are due to the action of some toxic body which is absorbed into the blood stream subsequent to intestinal obstruction, the nature of which is not known. The rise in non-protein nitrogen in the blood, in the absence of any kidney disease, is an indication of the extent of protein destruction taking place as a result of the toxæmia. The fall in chlorides suggests that the chlorides are being used as a protective agent against the toxic body. The alkalosis is probably an incident in the chloride metabolism in which the sodium ion is released due to the utilization of the chloride ion and unites with carbonic acid to form sodium bicarbonate.

If the assumption be correct that the chlorides in intestinal obstruction are used as a protective agent against the toxic body, the administration of sodium chloride is then indicated. In one patient (Case 2), 90 grams of sodium chloride were given subcutaneously during the first 36 hours after admission to the hospital with but 1.8 grams appearing in the urine and without a rise above normal in the blood. This seems to show that the body tissues have utilized this supply of chloride and indicates its need in such conditions.

CONCLUSIONS

1. Definite blood chemical changes are found in acute intestinal obstruction, manifested by a fall in the blood chlorides, often a rise in the carbon dioxide combining power of the plasma and a rise in the non-protein nitrogen.

2. The fall in chlorides is considered the chief factor of this change and indicates that the chlorides may be utilized by the body as a protection against the toxic agent.

3. The administration of sodium chloride in larger doses than that supplied by physiological saline is indicated in acute intestinal obstruction as a means of directly combating the toxæmia.

4. Since an alkalosis is frequently present in intestinal obstruction, alkalies should be administered with caution.

5. We have estimated that in the presence of the toxæmia of intestinal obstruction that sodium chloride as an initial dosage of 1 gram per kilogram of body weight should be administered. The blood and urine chlorides should be closely followed to estimate the subsequent quantity of sodium chloride needed to keep the chlorides at a normal level in the blood.

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RETROPERITONEAL LIPOMA

Brief Summary of the Literature With the Addition of a Case of Our Own

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RETROPERITONEAL lipoma is an extremely rare condition. A surprisingly large number of cases, however, have been reported in the literature and the condition has been carefully studied and ably presented by several authors. The case we wish to report emphasizes many points which have already been noted, but we fell this will aid in establishing our knowledge of this disease.

The most careful and thorough article which has appeared lately is the article by A. L. von Wahlendorf. He reviews the literature up to 1921 and has collected 165 cases. He adds one of his own. Wahlendorf does not seem to have been aware of the work of Lecéne, who in 1919 reported 113 cases of solid paranephritic tumors. Many of these were lipomata. Although Wahlendorf has included most of these cases in his review, especially the earlier ones, some, which justly might have been included, have been omitted. Both of these articles contain excellent bibliographies. We have been able to find a few other cases in the literature, most of them published since Wahlendorf's article went to press. Walter Holmes reports one case, Masson and Horgan 12 cases. Hirsch and Wells report the largest tumor so far recorded. These authors also report a case of McConnell which to their minds was really a case of retroperitoneal lipoma instead of a hypernephroma which had undergone fatty degeneration, as McConnell thought. Heppner reported a case. These references plus the references given in the bibliographies appended to the articles of Wahlendorf and Lecéne cover all cases, so far as we know, reported in the literature to date.

Our case in many ways typifies the average case reported in the literature. The condition is more common in the female than the male; 72 per cent as compared to 28 per cent in Wahlendorf's series. It occurs at any age although most of the cases were found between the ages of 40 and 60. Bork and May report a case in a child 1 year old, Masson and Horgan one in a patient 72 years old.

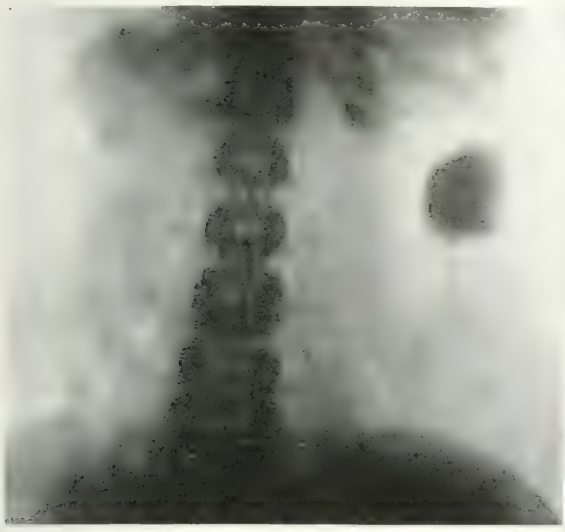

Fig. 1. X-ray plate showing round opaque mass in left side of abdomen. This mass corresponds to the calcified mass later found encapsulated in a tumor.

Fig. 2. X-ray taken 2 hours and 10 minutes after bismuth meal, showing stomach and small intestines filled with bismuth. It is interesting to note that the small intestines lie entirely in the right side of the abdomen. The tumor masses evidently occupy the entire left side. The shadow in the left side (within the mass) corresponds to the shadow seen in Figure 1.

The tumor is usually situated in the abdominal cavity, but it may be in the pelvis—79 per cent and 21 per cent respectively in Wahlendorf's cases. The tumor usually arises from the paranephritic or lumbar fat, but it may arise from the renal capsule, the mesentery, the pararectal and retrorectal fat, as well as from other retroperitoneal sites. It occurs about equally on either side of the abdomen. The type of tumor varies. Wahlendorf found pure lipoma in 46 per cent and mixed forms in 54 per cent of the cases. Of the mixed forms 20 per cent were fibrolipoma, 10 per cent mixolipoma, 10 per cent fibromixolipoma, while the remaining 14 per cent of the 54 per cent were sarcomata. Of Masson and Horgan's series 2 out of 12 cases had undergone sarcomatous degeneration.

The size of the tumors reported varies from very small tumors to tumors of enormous size. They have a tendency to attain tremendous proportions. Hirsch and Wells report the largest on record—the tumor weighing 69 pounds, a liposarcoma, which filled the entire retroperitoneal space. In this case it is interesting to note that although the patient was emaciated to an extreme degree the tumor had been storing up fat.

One of the striking characteristics of retroperitoneal lipomata is the absence of discomfort. Growth in size of the abdomen was the most common, and usually the earliest, symptom. Masson and Horgan sum up the symptomatology of their 12 cases as follows: In 6 cases the presence of the tumor was first noticed by the patient, in 3 the physician discovered the tumor, 6 complained of abdominal pain, 2 pain in the back. In only 1 case was the pain very severe. Six cases complained of food distress, 2 vomited, 5 were constipated, 6 lost in weight. In the case of a degenerating lipoma the symptoms are apt to be acute. The duration of symptoms varies from a few months to many years.

The prognosis is grave. Of 113 cases in Wahlendorf's series, the operative mortality was 25 per cent. This is high because it includes the early cases. Of cases reported since 1910, the operative mortality has been 14 per cent. The figures of Lecéne correspond closely with those of Wahlendorf. Masson and Horgan's mortality was 16 per cent. Injury to the large vessels is the chief danger at operation, as the tumor is apt to surround the large mesenteric vessels, making the dissection extremely difficult.

Fig. 3. Gross section of the tumor taken after having been hardened in formalin. At the lower left-hand corner of the tumor can be seen the calcified masses which constitute the shadow in the X-ray pictures, Figures 1 and 2. This picture shows the large dimensions of the tumor, about 21 centimeters in long diameter.

Recurrences are frequent. Just how frequent is very difficult to say. Of the 113 operative cases reported in Wahlendorf's series, 15 recurrences are noted. Wahlendorf claims that this obviously is too low because among 60 cases listed as "cures" without recurrence 18 were sarcomatous; also of many cases listed as "incomplete removal" only one was noted as having recurred. Lecéne reports recurrences as numerous. In Masson and Horgan's series one case had 3 recurrences, another 1.

The clinical diagnosis is difficult. In our case, we thought a kidney tumor most likely. We confess that the condition of retroperitoneal lipoma did not enter our minds. Had we been as familiar with the literature on this subject then as now we might have considered it.

Retroperitoneal lipoma has been mistaken for almost every possible intra-abdominal condition. Masson and Horgan tabulate their cases to show the pre-operative diagnosis and state: "It is noteworthy that the percentage of error in the clinical diagnosis of retroperitoneal lipoma is very high."

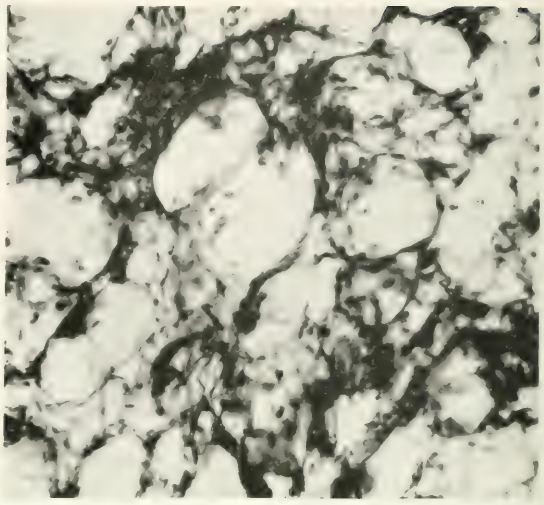

Fig. 4. Photomicrograph of a section of the tumor showing the fairly typical lipomatous character.

Mrs. R. K. (54) entered the hospital July 12, 1921, complaining of swelling of ankles, numbness of left leg, and a lump in the left upper abdomen. For years (20) patient had noticed a lump in the upper right abdominal quadrant which had increased slowly in size and which at no time had caused her any inconvenience. This mass had been examined by numerous physicians who differed as to the diagnosis but concurred in the opinion that no operative interference was indicated. For the last 4 or 5 months patient had noticed that her ankles were swollen at night. The swelling was painless and were it not for the fact that her shoes felt tight in the evening might have passed unnoticed. With the swelling patient had noticed a feeling of numbness. Otherwise she felt well. She had been in perfect health all her life. There had been an occasional headache, at times she had had abdominal discomfort following indiscretion in diet, occasional constipation, but on the whole had been as free from complaints as any average normal individual.

On examination Mrs. R. K. was found to be a well-nourished, healthy-looking individual about 54 years old, lying quietly in bed with no apparent pain or discomfort. Physical examination revealed nothing bearing on the condition except for the abdomen. The extremities were normal, there being at the time of the examination no swelling of the ankles. The contour of the abdomen was normal. There was no tenderness or rigidity. A mass was palpable in the left side reaching from the costal margin down almost to the crest of the ilium and extending from the flank almost to the mid-line. The mass was smooth, regular, apparently slightly movable with respiration, firm but not hard, not tender. Gas-containing intestine seemed to lie over it. The urine was normal. Cystoscopic examination

with ureteral catheterization failed to reveal any abnormality. Tests showed normal urinary function. Blood counts were normal. Hæmoglobin was 85 per cent. X-ray examination showed a small, round, opaque mass about the size of a hen's egg lying on the left side of abdomen about the level of the iliac crests. Except for the fact that the intestines seem to be displaced to the right side of the abdomen an opaque meal and enema revealed nothing pathological. The large mass which was palpable cast no definite shadow. No definite diagnosis could be made, but, inasmuch as the tumor was growing to such a size as to produce pressure symptoms, it was deemed advisable to perform an exploratory laparotomy. Three months later, after a trip to California, the patient re-entered the hospital for operation. Her condition at that time was exactly as on previous admission.

Under ether anæsthesia the abdomen was opened through a left pararectal incision. A large tumor was found which was definitely retroperitoneal. The descending colon was pulled to the right and an incision made to the left of the colon. A firm, unencapsulated mass, the size of a small orange, was easily removed by blunt dissection. Another much larger mass was then shelled out of the retroperitoneal space. This mass was about 6 inches in diameter. There was very little bleeding although the mass extended over to the mid-line and seemed to be grooved by the large mesenteric vessels. These masses were of a lemon yellow color and were definitely composed of fatty tissue. The lower pole of the left kidney was palpated retroperitoneally and seemed free; the kidney itself was not enlarged and was normal on palpation. Careful inspection showed no more tumor tissue. There was no bleeding. The pericolic incision was closed with catgut. The abdominal incision was closed in layers with catgut. The patient left the operating room in good condition. The convalescence was uneventful. And now, 1 year since operation, there are no return symptoms, nor can any tumor mass be palpated.

The report returned from the pathology laboratory by Dr. O. T. Schultz was as follows:

Pathologic diagnosis: Fibrolipoma of retroperitoneal tissue, with degeneration necrosis and calcification.

Gross specimen consists of a large amount of tissue composed of lobulated masses from 4 to 12 centimeters in diameter. These are covered by a thin fibrous capsule. They vary somewhat in consistency, but all are rather soft. On section the 2 largest masses have the appearance of pale yellow fat which is somewhat firmer than normal adipose tissue. A third large mass is pale, firmer, contains less fat, and is centrally calcified in a small area. The smaller masses are in part yellow and fatty, in part paler and more translucent. One separate lobule 4.5 centimeters in diameter is transformed into a completely calcified mass covered by a fibrous capsule. A second lobule 2.5 centimeters in diameter is similarly calcified.

Microscopic. Microscopically the tissue shows as great a variation as it did in the gross. The softer, yellowish nodules are composed chiefly of adipose tissue, whose lobules are small. The paler denser nodules are composed almost entirely of connective tissue. The latter is dense, and in places hyalin, degenerated, with a few nuclei, and poorly vascularized. Other nodules are composed of fibrous and adipose tissues intermingled in varying proportions. There is nowhere anything to suggest malignancy.

In summary we might write that retroperitoneal lipoma are most apt to occur in elderly individuals, and usually in women. The symptoms are vague, varied, swelling of the abdomen being the most constant one. The prognosis is poor. The operative mortality is high, about 15 per cent, due to the likelihood of injuring the large abdominal blood vessels. Recurrences are frequent. The tumor may be a pure lipoma but is apt to be a mixed tumor; sarcomatous degeneration is likely to occur. The tumor may arise from almost any retroperitoneal location but most frequently has its origin in the pararenal fat. Clinical diagnosis is difficult.

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SARCO-CARCINOMA OF THE UTERUS

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IN the group of the mixed tumors undoubtedly the most interesting ones are those which show the combination of carcinomatous and sarcomatous tissue. This combination may be due to the growing of a carcinoma and a sarcoma into one another, both of them taking origin in different parts of the same organ. Or the carcinoma as well as the sarcoma may arise from the same place. The name sarco-carcinoma should be used only for this latter type of tumor (von Hausemann).

There are three possibilities to explain the histogenesis of the sarco-carcinomata. First, the carcinoma may have been the primary tumor, the stroma of which changed into a sarcoma. Or the sarcoma may have been followed by the carcinoma. Finally both the tumors may have developed at the same time. Important facts were reported for each of these modes of origin, but in most of the cases it hardly will be possible to decide exactly which of the two tumors was the first one, the carcinomatous and sarcomatous part usually being connected very closely. On account of this close connection of epithelial and mesenchymal formations, doubts have arisen whether in these tumors there is a real combination of sarcoma and carcinoma or whether the sarcomatous character of the tumor is not only stimulated by the cells of the carcinoma taking up mesenchym-like shape (Ewing, Krompecher, Herzog). Every pathologist, no doubt, has experienced how difficult it may sometimes be to decide whether a tumor should be called sarcoma or carcinoma. I recall particularly the melanomata of the skin and the malignant tumors of the hilus of lung formed by small spindle-shaped cells (Marchand, Arnstein, Jaffé and Sternberg). In the primary tumor the distinctly alveolar arrangement of the cells will strengthen the diagnosis of carcinoma. But the diagnosis of spindle-cell sarcoma will sometimes be made, if only a metastasis in the skin has been examined.

Most of the tumors formerly reported as sarco-carinomata are surely pure carcinomata with partly sarcoma-like appearance of the tumor cells. This has been fully discussed in Herxheimer's critical paper and in the summary in Ewing's excellent book. But, on the other hand, there can be no doubt about the existence of a group of tumors, representing a true combination of carcinoma and sarcoma. The proof of this is twofold: the experiences of the experimental tumor pathology and the formation of connective-tissue material in the sarcomatous part.

A considerable number of observations now exist concerning spontaneous, transplantable tumors, most of them being found in mice which have changed their microscopical structure from a medullar or glandular carcinoma into spindle-celled sarcoma during the course of the transplantation (Bashford, Erhlich and Apoland, Murray and Howland, Russel, Woglom). The carcinomatous part finally disappeared. Also in cases of experimental carcinoma produced in mice by painting the skin with tar for a long time the development of sarcoma in a typical carcinomatous ulcer was reported (Deelman). Like the X-ray, tar seems to possess the irritating power of producing both carcinoma and sarcoma and this not only in the same organ (skin) but sometimes even at the same place. But here, too, the possibility that the carcinoma may assume a sarcoma-like appearance must be acknowledged as demonstrated in the report of Bierich.

The elaboration of intercellular material, such as collagen, cartilage, and bone, can only be due to cells derived from mesenchyme. Therefore, if in the sarcoma-like part of a mixed tumor the formation of one of these intercellular substances is to be found, the name sarcoma for this part of the tumor seems to be strengthened (W. H. Woglom). Unless one could assume, as Krompecher does, that under pathological conditions epithelial

cells, losing all their characteristic qualities, may change into connective substances. Nevertheless, a malignant tumor showing all signs of sarcoma can only be called sarcoma.

Tumors that have definitely originated as a result of simultaneous malignant neoplastic growth of epithelial cells and stroma are rare in man. All together about 32 cases have been reported, most of them being found in the uterus, œsophagus, and thyroid gland (Brunn, Herxheimer, Klee, Kleinschmidt, Krompecher, Saltykov, Simmonds, etc.).

The carcinomatous parts of these tumors represented either the type of adenocarcinoma or of squamous-cell carcinoma. There were also some tumors in which adenocarcinoma and squamous-cell carcinoma could be found side by side (Stein, Klee, Saltykov). The columnar cells had been transformed by metaplasia to squamous cells.

The sarcomatous portions were described as round-celled, spindle-celled or giant-celled sarcomata. By reasons mentioned above, I emphasize those cases in which the sarcoma represented higher stages of differentiation. Such are the cases of Saltykov (fibro-myxo-sarcoma, osteo-chondro-myxo-sarcoma), Kaufmann (chondro-sarcoma) and Kleinschmidt (myo-sarcomata).

The tumor to be reported here is interesting, because the early stage of the development of the sarcoma permits its histogenesis to be easily recognized.

Woman, age 35, married, stated that for the last 10 to 12 years she had trouble with ulcers along the generative tract. However, she seemed to be fairly well until about 4 or 5 months ago, when she noted that she was bleeding from the vagina. At first the bleeding was very small in amount, but gradually it became greater in amount and more persistent. Lassitude has been present for a long time. Since the clinical examination proved a tumor of the portio uteri suspicious for carcinoma the uterus was removed (Dr. Zimmerman).

Macroscopical state of the uterus: The uterus is slightly enlarged, its diameters being 8.75, 7.5, 5 centimeters. The corpus is deformed by several spherical, intramural myomata, the largest of which has a diameter of 2.5 centimeters. One and one-fourth centimeters behind the right tubal corner there is a small subserous myoma attached to the uterus only by a narrow pedicle of connective tissue. Almost the entire surface of the portio is changed to an irregular ulcer with uneven base. Coagulated blood covers grayish red and small papillæ. On the right side of the portio a spherical firm nodule, 1 centimeter in diameter, can be noted. The cross section through this nodule shows a whitish, distinctly striped cut surface with small faded reddish areas near to the external surface. The mucosa of the corpus and cervix is smooth and pale.

Fig. 1. Microscopic section showing large spindle cells between carcinomatous alveoli.

The microscopical examination shows that the ulcerated tumor of the portio is made up of cells of different form and size which are arranged in smaller or larger alveoli. The alveoli are often connected and so produce an irregular network. The majority of the cells at the periphery of the alveoli are small. They appear dark because of the large content of chromatin of their oval nuclei. In the central parts the nuclei are larger, and a granular meshwork of chromatin can be recognized on a faintly blue stained ground (hæmatoxylin-stain). Most of the nuclei contain two or three small, but very distinct, nucleoli. Extremely seldom the cells of the center manifest the tendency of forming small and rudimentary horn pearls. In some of the larger alveoli a considerable amount of fat droplets within their cells can be stated. There are in every alveolus an abundant number of mitoses, many of them being atypic, hyperchromatic, asymmetric, or multipolar.

The alveoli are separated by a stroma which shows an exceedingly variable and intricate structure. First there is to be found a very intensive inflammatory reaction. Dense infiltrations composed by lymphocytes, plasma cells, polymorphonuclear leucocytes and a great many eosinophile leucocytes surround the alveoli. Leucocytes often invade the areas of the carcinomatous cells and can

be distinguished between them by their characteristic nuclei. The alveoli seem at times quite disorganized by the breaking in of the inflammatory cells. Other alveoli appear compressed by the mighty infiltrations and their cells have become elongated and spindle shaped.

In some areas an increasing amount of fibroblasts join the round cells and leucocytes. In the deepest and apparently oldest parts of the tumor, the stroma is formed by a very dense and firm connective tissue consisting of fibrillar and partly hyaline intercellular material and of small cells with dark nuclei. In these parts the alveoli of the carcinoma are small and widely separated. Here and there one or two isolated carcinomatous cells showing signs of disintegration may be seen.

In that part of the tumor macroscopically described as a spherical and firm nodule, the microscopical examination discloses an uncommon and very interesting state of the stroma. Large accumulations of inflammatory cells and dense fibrous tissue about the alveoli can also be noted here. But in the fibrous tissue larger and more irregular cells appear. These cells take up spindle shape, they become more and more numerous, while the intercellular material becomes reduced. There is finally an area where the stroma is almost formed only by large spindle cells arranged in fascicles which interlace in various directions (Fig. 1). The spindle cells contain large nuclei with distinct structure of the chromatin, but no nucleoli can be seen. Atypical mitoses are very frequent.

It may be questioned whether these spindle cells are really cells of the mesenchymatous stroma or whether they are cells of the carcinoma changed to spindle cells by the pressure of the surrounding tissue. To answer this question seems to be necessary, because it was observed that the cells of the present carcinoma sometimes become spindle shaped due to the action of the proliferating stroma. Yet we find some characteristics which will enable us to determine that these spindle cells which grow exuberantly are derived from the mesenchyme. I will not insist upon the different form and structure of the cells and their nuclei. It can be admitted that these differences are not in themselves sufficient for a sure decision. I agree therein with Ewing, Herxheimer, Herzog and Krompecher.

But the questionable cells produce collagenous intercellular material. Stained with van Gieson's picric acid and acid fuchsin mixture the spindle cells appear yellowish. Not seldom, however, it can be seen that the peripheral part of the cells takes up a pinkish color and this part of the cell body passes over to faintly reddish, band-like masses between the cells. Sometimes the cells are separated by a more distinctly red meshwork of fibers with which they are inseparably connected.

One other fact determines the bundles of spindle cells as belonging to the stroma. I mean the distribution of the blood vessels. Blood vessels never can be found within the areas of the cells of the carcinoma, even they may appear as spindle cells. The vessels are limited to the stroma and that also in these parts where it is formed by the sarcomatous spindle cells.

By these reasons the present tumor may be considered as a combination of a squamous-cell carcinoma with a spindle-cell fibro-sarcoma. I do not hesitate to call it a sarco-carcinoma.

What may be the genetic relation of the two components of this tumor? R. Meyer suggests that in most of the sarco-carcinomata the carcinoma followed the sarcoma. Other observers (Simmonds, Klee, Stein) consider the carcinoma and sarcoma as having originated at the same time, while Kleinschmidt supposes that the carcinoma produced a sarcomatous reaction of the stroma.

In the present tumor a very strong reaction of the stroma against the invading carcinoma was to be noted. It could further be seen that on one place the proliferation of the mesenchymatous tissue exceeded the limits of the normal representing all characteristics which are considered as significant for malignant tumors of the connective tissue. I believe, therefore, that the carcinoma caused the sarcomatous degeneration of the stroma. But it was not a common stroma which reacted in this atypical way against the irritation by the carcinoma. The tendency for its excessive growth pre-existed and the carcinoma merely enhanced this state. In the portio of this uterus there was the disposition for malignant new formation in both the epithelium and the mesenchyme. The carcinoma became at first manifest and caused at the same time the manifestation of the sarcoma.

Carcinoma and sarcoma grow against each other and in the majority of these tumors the sarcoma will finally prevail owing to its greater power of proliferation (Herxheimer). The metastatic tumors which were found in cases of sarco-carcinoma represented either only sarcomata (Cullen, Forsner, Ivanoff, Stein), or sarcomata and carcinomata (Saltykov). About metastases in our observation nothing is known.

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CONGENITAL FIBULAR DEFECTS

With the Report of a Case of Bilateral Congenital Total Absence of Fibulæ

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CONGENITAL absence of fibula, partial or complete, is not of itself such a serious condition. Corner mentions five cases between 40 and 47 years of age who had led active lives without any fibula. The lack of an external flange to the tibio-astragalar mortice is more troublesome than the disturbance to the fibular muscles. Usually, however, there are accompanying abnormalities which complicate the mechanics of the leg and foot to such a degree as to make treatment far from simple. There is frequently absence of the fifth, or fourth and fifth toes, together with more or less disturbance in the lower epiphysis of the tibia, the astragalus, calcaneus, and cuboid. A foot is thus presented which seldom lends itself to reconstruction by manipulation or operation. Doubtless, before the advent of X-rays, many cases escaped notice but especially were errors made in judging the entire bone to be absent when some part was present which the X-ray would have revealed. As the condition is usually accompanied by an anterior bowing of the tibia with what is apparently a scar over the convexity, it was thought that intra-uterine compound fracture had taken place, and the classification was therefore frequently erroneous.

Cotton and Chute cite a case as congenital absence of the fibula which was reported by L. Proudfoot in 1846 as follows: "Right foot showed equino valgus. Tibia of same limb seemed to have compound fracture at middle, union slightly salient anteriorly. Cicatrix on skin over point of fracture." Guyot and Charbonnel report: "Cicatricial depressions at the angles of deformation are always present in these cases, due to amniotic pressure."

This cicatricial tissue was examined histologically by Handek, Hoffa and Kirmisson and determined by each to be an atrophic degeneration of the skin rather than a true cicatrix. In many case-histories the presence of the scars is noted, but its absence has been remarked in a number, and only 27 per cent of Schaff's cases showed scars.

Gaenslen supports the view of Braum, expressed in 1886, that these scars are healed pressure sores, emphasizing the fact that "similar scars and also bursæ have been found over the prominent external malleolus in extreme cases of congenital club foot and over the head of prominent subluxated fibula." Furthermore a scar has been reported over the tip of a very sharp and prominent but not defective coccyx in a case of congenital tibial defect. These cases are cited to show that scars have occurred not only apart from bone defects, but if co-existent, remote from them, so that they cannot be brought into etiological relationship. These scars have never been observed over large flat surfaces, as the back or sides of the abdomen, where closer and more intimate contact must be assumed, than over the more

Fig. 1. Showing patient's feet before operation.

freely movable extremities. Moreover, the scars are found with greatest frequency in cases where the angulation is sharp, and are absent, as in Gaenslen's own case, where there is but slight bending.

The consideration of the etiology of this condition is much clarified by ruling out defects of the fibula associated with intrauterine fracture, amputation and other conditions such as pseudo-arthrosis, and limiting our subject to those cases in which the total or partial absence of the fibula is accompanied by interference with the normal development of other bones of the leg or foot, especially the outer two toes. The amniotic theory is usually accepted as correct. Probably the pressure of amniotic bands occurs during the period from the fifth to eighth week of fetal life and whether external traumatism is a causative factor is questionable.

The diagnosis is not difficult. Palpation is usually sufficient. The absence of external malleolus with an equino valgus foot, the absence of one or more toes with their metatarsals, a shortened tibia with an angulation in its lower third and a small mark or pseudo scar over the curve, furnishes a pathognomonic picture. There are cases, however, of fibula defects where the external malleolus is present and no foot deformity exists other than a slight equinus.

The roentgenograph is of great help and will clear up the condition of the epiphyseal cartilage of the tibia and the absence or changes in the tarsal or metatarsal bones.

Treatment in the majority of cases is unsatisfactory. In a typical case the normal bones will not lend themselves to the construction of a foot even approaching the normal. If, however, this can be done, the replacing of an absent external malleolus may be attempted by a bone graft from the tibia, or an ankle brace with a free joint can be adjusted to retain the foot in the proper alignment.

Patient, 9 years of age. Height, 42 inches. Weight, 48½ pounds. Wassermann negative. Urinalysis showed nothing abnormal. Family history failed to reveal any congenital deformities even in the collateral branches.

Examination showed a boy with good general constitution, dwarf-like in appearance and with markedly deformed feet. It was quite evident the shortening was limited to the legs below the knees. In comparison with other children of the same age, with same length femur, the shortening was estimated to be 4½ inches. Measurement of the arms showed no inequality and both were of normal length. Length of legs from the anterior superior spine to the internal malleolus, 17½ inches; the tibiæ were 6½ inches. No fibulæ could be palpated. Over the crest of the marked angulation in the lower half of the tibia there was apparently a scar of ½ an inch in length. There were three toes on each foot. Left foot was in equino-valgus. Movement was greatly restricted at tibio-tarsal joint and absent at the medio-tarsal joint. Right foot was much more deformed. It was plantar flexed at the medio-tarsal, bringing the forefoot to a right angle with the heel and everted so as to face the plantar surface of the foot outward and backward.

The X-rays showed the left foot to have a rudimentary astragalus and united with the os calsis, cuboid and scaphoid so as to form one bone, or the cuboid might be considered as absent. In the right foot the os calsis and scaphoid were united, and the line of the axis of this bone brought into a line almost parallel with the axis of the tibia but extending downward and outward. Both forefeet showed the presence of three toes with accompanying phalanges and metatarsals and only two cuneiform bones.

January 9, 1922. Under an anæsthetic an attempt was made to correct the deformities. Two weeks later he was allowed up in casts. The result of this operation showed no improvement.

The impossibility of reducing the deformities with or without a mobile foot and furthermore the interference with the function of the epiphyseal cartilage made us decide to amputate with the expectation of giving good appearing and functionally useful feet and with restoration of a normal length to the legs.

June 5, 1922. The right foot was amputated by the Syms operation.

June 19, 1922. Same operation on the left foot.

After a month, wooden peg legs were applied. These were made so as to be removable.

December 12, 1922. Artificial feet were applied.

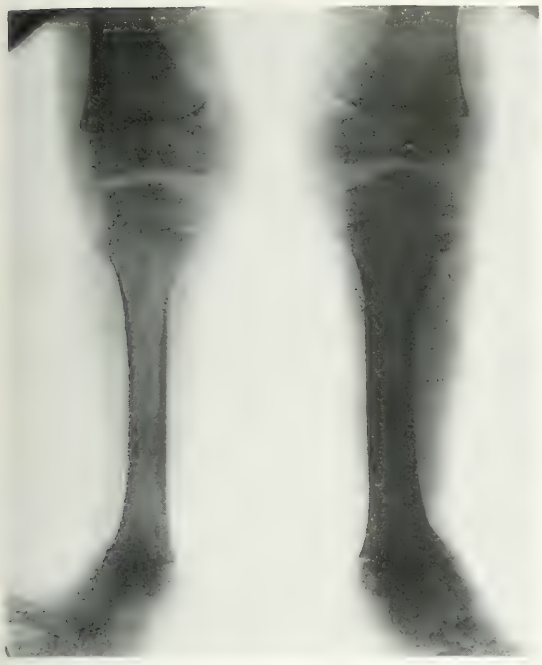

Fig. 2. Roentgenogram before operation.

A study of the literature of this condition reveals a vast number of articles in many of which statements appear of a number of cases seen or culled from the literature without any specific report or reference.

Rivorola quotes the statistics of Vegas in which only one case of absent fibula was noted in 1,336 patients in a children's surgical service. He also gives his own statistics covering the years 1902 to 1913 in a children's surgical service in which he reports 12 cases or one in about 3,000 of various surgical conditions and only one of these is bilateral.

Handek in 1896 published 97 cases which he found recorded and gave six additional cases of his own. Of these 6, 1 was a total absence of the fibula, but the others are of doubtful conditions. He is usually credited with 103 cases but I would reduce this to 98, tabled as follows:

	Cases
Total unilateral absence of fibula	45
Total bilateral absence of fibula	23
Partial unilateral absence	24
Partial bilateral absence	5
One not given	1
	98

Fig. 3. Two views of patient showing artificial feet applied.

Schaff in 1909 presented 6 cases of his own and collected 49 others from the literature; a few of these had been overlooked by Handek, the rest had occurred since Handek's article. Of the 55 there were:

	Cases
Total unilateral absence	28
Total bilateral absence	13
(No further information)	2
Partial unilateral absence	8
Partial bilateral absence	2
No information as to whether they were total or partial	2
Total	55

Handek and Schaff have together reported 153 cases, 36 of which were total bilateral. We give 29 cases overlooked by them and 30 found in the literature since Schaff's article, making the total to date, 213, with the case herewith reported. These are all in chronological order.

Case 1. Tyrie, C. C. B. Partial unilateral absence; lower two-thirds of fibula. The fibula ended in a point from which a fibrous band could be felt stretching down to and becoming lost in the region of the external malleolus.

Case 2. Freer, E. L. Boy 7½ years. Left tibia absent and fibula, 6 inches in length only, lay obliquely across the knee below the condyles. Foot attached to external malleolus and turned up against inner side of thigh. Four toes. Amputation. Right tibia normal, fibula rudimentary, extreme valgus of foot, 4 toes. Peronei tendons divided, foot inverted. Fall during pregnancy.

Case 3. Walsham, W. J., and Hughes, W. K. Congenital total unilateral absence.

Case 4. Whitman, R. Unilateral total (?) absence fibula.

Case 5. Tubby, A. H. Complete unilateral absence; intra-uterine fracture of tibia. Fall in fourth month of pregnancy.

Case 6. Steel, A. J. Unilateral complete absence. "No external malleolus was present, at least the fibula could not be felt." A scar two and a half inches long existed in the skin over the lower third of the spine of the tibia.

Case 7. Steele, A. J. Unilateral partial absence.

Case 8. Steele, A. J. Unilateral total absence.

Case 9. Morestin H. Left leg terminated by a stump in lower third. Dissection found no trace of fibula. Right leg, much reduced in size, had no fibula. Three toes. Many other deformities.

Case 10. Delanglade. Bilateral total absence. Double genu valgum. Curvature of tibiæ. Four toes only. Hypospadias. At 1 year absolutely no club foot, perfect functional activity. Walked, ran. Child first seen at 6 months, and mother instructed to manipulate feet.

Cases 11 and 12. Kirmisson, E. Kirmisson reported 2 bilateral cases, 2 right total and 2 partial unilateral.

Handek and Schaff have reported of those 1 bilateral total, 2 right total and 1 partial unilateral, omitting 1 total bilateral and 1 partial unilateral.

Case 13. Cotton, F. J., and Chute, A. L. Complete unilateral absence fibula.

Case 14. Cotton, F. J., and Chute, A. L. Partial unilateral absence fibula.

Case 15. Cotton, F. J., and Chute, A. L. Partial unilateral absence fibula. (No epiphysis.)

Case 16. Roubinovitch, J. At birth the umbilical cord was wound around the lower extremity of the left leg. In cutting this an accidental incision of the skin occurred, which has left a scar. Roentgenograph shows absence of the fibula, a very short tibia, thin and slightly curved.

Case 17. Hendrix. Absence (probably total) of both fibulæ. Each tibiæ showed pronounced anterior curvature, each with a sort of umbilical depression. The Achilles tendons were greatly retracted.

Case 18. Taylor, H. L. Presumably unilateral total absence. No full description of case. Photograph, right leg normal, left shortened 5 inches, 2 toes missing.

Case 19. Piquand. Durin's case (no reference). Unilateral partial absence.

Case 20. Piquand. Phocas, "Lecons cliniques de chirurgie orthopédique." Paris, 1895. Unilateral partial absence.

Case 21. Dubrac, R. Complete absence of one fibula. (Roentgenogram). Adherent scar. Operation.

Case 22. Dubrac, R. Complete absence of one fibula—large scar. (Roentgenogram.)

Case 23. Dubrac, R. Complete absence of one fibula. Roentgenogram shows complete absence of external malleolus and lower third, but a fibrous cord was present in the upper portion. Small nonadherent scar.

Case 24. Dubrac, R. Absence external malleolus (one side). (Roentgenogram.)

Case 25. Dubrac, R. A typical case of absence of fibula in woman 58. The single large bone which formed the skeleton of the leg differed totally from the fibula both in diameter and upper and lower articulations. This is similar to Klaussner's fourteenth observation; Klaussner declared this bone to be the tibia.

Case 26. Dubrac, R. Man 32. Roentgenography showed unilateral partial absence of fibula; complete atrophy of middle portion; the external malleolus was a fragment 4 to 5 centimeters long terminating at the upper extremity in a fine point. The head was normal, but the bone rapidly diminished.

Case 27. Del Greco, E. Complete unilateral absence of fibula.

Case 28. Gray, G. M. (Elderly female.) Unilateral partial absence. No fibula could be palpated from the outside. The fibula was represented by a stout fibrous cord for the greater part of its extent. Toward its lower end it became cone-shaped and hollow, the space being filled up by a mass of spongy bone. At its extremity it presented a disc of dense bone, with a smooth, cartilage-covered facet for articulating separately with the tarsus. At the upper extremity, the fibrous fibula was directly continuous with the external lateral ligaments of the knee joint.

Case 29. Docky, H. Total unilateral absence of fibula. Angulation of tibia, cicatrix, 4 toes; other leg normal except for one missing toe. Roentgenogram. Etiology: Nothing significant except violent abdominal pains at end of second month of pregnancy. The writer raises question of intoxication of the germ.

The following 26 cases were reported since the article by Schaff.

Case 30. Kofman, S. Right leg congenitally absent from knee down. Left leg, total absence of fibula.

Case 31. Anzilotti. Complete absence of fibula (one side) with malformation of tibia, absence of 5th toe and integrity of fibular musculature.

Case 32. Guyot and Charbonnel. Bilateral partial absence of fibula. Roentgenograms showed just a trace, very small and atrophied, of fibulæ at their lower extremity. The tarsal bones were atrophied and deformed, particularly the astragalus. Scars.

Case 33. Dienlafe, L. Total absence of both fibulæ (roentgenograms at 3 and 8 years). There was incurvation of the right tibia; at the age of 3 years, there was an oblique fissure in the angulation; this was no longer present at the eighth year. Operation on both legs. Child can walk and play, etc.

Case 34. Perriol. Total unilateral absence of fibula (roentgenogram). No fifth toe; posterior concavity of tibia; no cicatrix or signs of intra-uterine fracture.

Case 35. Rendu, A. Complete unilateral absence of fibula. At the height of the tibial angulation, there was a deep cutaneous scar, very adherent, from an amniotic band.

Case 36. Le Breton, P. Unilateral total absence of fibula.

Case 37. Le Breton, P. In both cases, absence of lower epiphysis of tibia; bent tibiæ with scars.

Case 38. Klar, M. Unilateral partial absence of fibula. Bone present in upper and lower extremities with about 7 to 8 centimeters lacking in middle.

Case 39. Hesse, Fr. A. Total absence right fibula; atrophy of left fibula. Volkmann's ankle defect, particularly external malleolus.

Case 40. Corner, E. M. Infant with deformity of left leg. Femur and patella normal; leg curved in lower part, 4 toes only present. Situated over convexity of bent tibia was a "scar" slightly adherent to the bone. This "scar" avowedly suggested the previous presence of a compound fracture of the tibia. A roentgenogram of the leg showed curvature of the tibia, absence of fibula, the astragalus and calcaneum represented by one bony cartilaginous mass; a deformity of the cuboid, absence of the fifth toe, with outward deflection of the leg and some talipes vagus.

Case 41. Rocher, H. L. Complete unilateral absence.

Case 42. Gaenslen, F. J. Partial absence of right fibula, upper epiphysis not formed, lower small; no scar.

Case 43. Gaenslen, F. J. Complete absence of fibula, slight angulation of tibia; scar.

Case 44. Gaenslen, F. J. "Intra-uterine fracture." "Partial defect of both tibia and fibula."

Case 45. Gaenslen, F. J. Complete absence of one fibula.

Case 46. Gaenslen, F. J. Apparent complete absence of one fibula.

Case 47. Gaenslen, F. J. Complete absence of one fibula, tibia bent. Scar.

Case 48. Albee, F. Boy 5 years. Foot and lower third left leg absent; right fibula entirely absent.

Case 49. Albee, F. "Only a portion of the lower half of the fibula absent."

Case 50. Ashhurst, A. P. C. Boy 7. Congenital absence of right foot and congenital malformation of the left. Right knee joint normal, but no right fibula. Left knee joint normal, but no left fibula and outer two toes and corresponding portions of foot absent.

Case 51. Rivarola, R. Left fibula; total absence. Right fibula; partial absence (upper two-thirds).

Case 52. Rivarola, R. Unilateral partial absence.

Case 53. Rivarola, R. Unilateral total absence (also patella). Congenital cicatrix.

Case 54. Rivarola, R. Infant 4 days. Unilateral total absence to palpation; tibia misformed; 2 last metatarsals and toes missing on both feet.

Case 55. Rivarola, R. Unilateral total absence. Well-marked skin-fold seen at anterior aspect of leg and on point of greatest concavity of tibial curvature; no cutaneous cicatrix. No missing toes or other deformity.

Case 56. Rivarola, R. Unilateral total absence. Pronounced tibial curvature; no cicatrix; 4 toes.

Case 57. Rivarola, R. Right tibia presented anterior protuberance with depressed cicatrix, 1 centimeter wide. Foot in valgus; only 3 toes. Left leg 8 centimeters shorter than right. No cicatrix, but outward rotation in distinct cone formation. Foot atrophied and in talus valgus position, with only 2 united toes. Heel formed by internal malleolus. (No definite statements about fibulæ.)

Case 58. Rivarola, R. Unilateral total absence; patella missing; all toes present. Congenital shortening of leg exclusively due to imperfect development of tibia; no curvature; foot in equino valgus position.

Case 59. Rivarola, R. Total unilateral absence; patella and 4 and 5 toes absent. Movements of limb practically entirely preserved.

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SURGERY OF THE SEMINAL VESICLES—INDICATIONS, TECHNIQUE AND RESULTS

Report of 135 Cases

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SURGICAL treatment of infections and pathological conditions of the seminal vesicles cannot by any means be called a common procedure. Several workers have been most prominently identified with pioneer exploration in this field in the past 20 years, and as yet there is no unanimity between urologists regarding the questions of treatment and particularly in the value of surgery.

In the light of subsequent knowledge, the technique of the early investigators was considerably inaccurate and their conclusions were sometimes erroneous. We know that in the early technique of vesiculotomy there was some possibility of error as regards results.

Fuller in a résumé of his cases published in 1909, "A Consideration of the Surgery of the Seminal Vesicles," reported in all 700 cases. These had been operated on for symptoms varying from neurasthenia and hysteria to chronic urethral discharge, sexual excitement, pain, rheumatism, and other causes. With the exception of 10 cases of which 7 were tuberculosis, he noted marked improvement and a mortality of but one.

In 1911, Koll reported a series of cases of vesicular disease in which he noted bladder symptoms of varying types, due to inflammatory changes in the vesicles. He called attention to the fact that, owing to the close relationship between the vesicles and the structures at the bladder base, it was easy to understand the symptomatology and urged a greater recognition of this etiology. Operation was not advised, however.

Squier, in 1914 in a careful study of the operative indications, expressed the opinion that the varied symptomatology of vesicular diseases was due to encapsulation by scar tissue—of the entire area, preventing proper emptying or drainage and thereby offering to the blood stream a constant supply of toxins. He had operated on a series of cases the preceding year. At this time an original operative procedure was described which greatly facilitated the exposure of the structures and their treatment surgically—thereby probably accounting largely for the good results reported. The entire procedure was accurately determined and carried out under the control of the eye, thereby differing from the Fuller method which was at best a blind procedure. Indications were summed up under three headings: (1) pus; (2) pain; (3) rheumatism; and the factor of chronicity figured largely in the selection of cases for operation. In cases with relapsing epididymitis, chronic prostatitis, perineal pain, etc., drainage, he thought, was indicated. Other foci having been carefully eliminated, a series of cases operated upon for rheumatic symptoms alone showed universally "immediate cessation or amelioration of the joint symptoms."

After a careful dissection of 100 specimens of pathological vesicles, Barnett called attention to the innumerable blind pouches that composed the mucus-lined interior of the structures and noted the possibility of retention cysts following inflammatory changes with no chance for drainage on account of duct obliteration. He noted further that one of every three cases showed an involvement of the ureter in the form of a stenosis at the point where it is in relation with the vesicle and vas. He stated that, in some cases, dilatation of the distal end of the ureter was already in progress. In his conclusions, he refers to the future of vesiculectomy as an operative field.

In 1913, Hugh H. Young urged that recognition be given vesicle infections as a focus in obscure joint and cardiac conditions as well as in urological affections. He believed the essential process to be an acinous

Fig. 1. Line of incision with central tendon undivided.

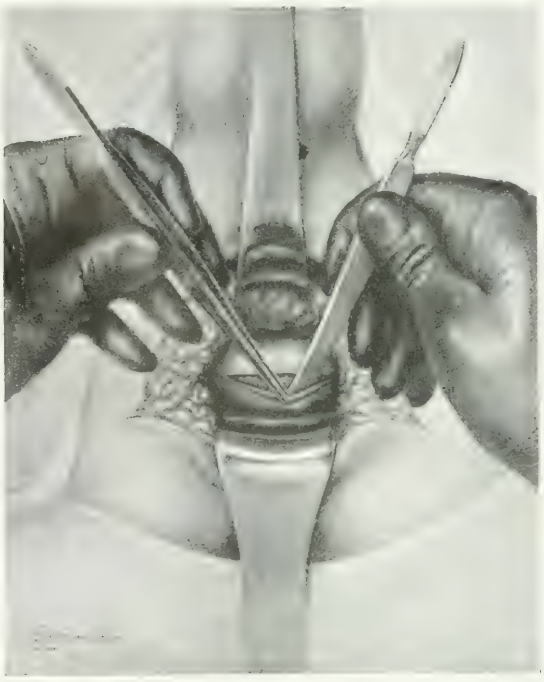


Fig. 2. Exposure of prostate; rectum retracted posteriorly. Method of identifying two layers of prostatic fascia. The deeper layer blends with the intervesicular fascia which covers the vesicles. Recognition of this second layer greatly facilitates the further operative procedure.

or periacinous inflammation within and without and about the vas deferens, and the seminal vesicles. He advised operation with excision and drainage as a radical, safe, and effective means of cure.

Young modified the technique of the Squier operation and combined several steps employed in the perineal operation for removal of the prostate, and it is his operation with several further modifications that we have employed in our work.

In the following year, Barney called attention to the fact that chronic infection of the vesicles decreased the amount of connective tissue locally, and the resulting contraction distorted and prevented a normal drainage. Barney thought that the poor results that he had observed following vesiculectomy were due to the prostate contributing to the infectious and toxic process. His observation was that cases showed not an interrupted convalescence but exarcerbation or infection of joints already quiescent.

Picker reported the study of a number of specimens with the conclusion that only 3 per cent of infected vesicles were able to drain normally, and he found a diversity of anatomical structure in the cases examined.

White, in 1916, made a careful study of the symptomatology, and he concluded that the results of medical and expectant treatment were unsatisfactory. In his article he lays considerable stress on the nervous symptoms, claiming that in 90 per cent of the cases, these were well marked and of long standing, the patients being highly neurotic.

Among other evidences of vesicle infection he stressed hæmospermia and pyospermia, diminution of sex strength, impotence, abdominal and perineal pain, and innumerable bladder symptoms. He believes that operation should be performed for three indications: (1) relief of pain, (2) the evacuation of pus, and (3) for the removal of hard, indurated fibrous vessels of long standing and productive of much discomfort.

Vesiculectomy is the operation of choice, he thinks, in long-standing cases with sclerotic vesicles, whereas vesiculotomy with drainage was found satisfactory in pus cases and the acute catarrhal forms.

In a study of 52 cases, of seminal vesiculitis, Stokes reported interesting conclusions. Eight of the cases required operation. He decided that seminal vesiculotomy was rarely indicated and should be done only where there was an empyemic vesicle with signs of sepsis. He claimed that the pathological condition would return when the wound was healed, and felt that, in all chronic infected vesicles, with a series of chronic symptoms, vasostomy should first be tried, then after consideration, vesiculectomy. He further states that seminal vesiculitis as a clinical entity is exceedingly rare and treatment of the seminal vesicles alone yielded imperfect and incomplete results.

A further comprehensive review of the literature would not be complete without including the work of Cunningham, who reported on a large series of cases at the Long Island Hospital, and who had gratifying results. He made careful analogous studies of the pathology of the vesicles and the roentgenology of the affected joints, and showed the actual changes resulting after the removal of the focus in the vesicles.

It can thus be seen that there is ample evidence and opinion both for and against surgical measures and procedures on the seminal vesicles and the subject can yet be considered as incomplete. We have had opportunity to operate on a large series of cases, and have already reported the pathological findings in a series of cases done on patients where the neurotic symptoms were pronounced.

To this number have been added some 35 cases until the series now comprises over 125 cases in all, embracing types from each group. The classification adopted by White and Cunningham of dividing cases according to their symptoms has been followed, and it would seem that this is an intelligent and comprehensive division. In addition, however, the local findings and condition of the vesicles on examination must be given great consideration.

In the presence of acute symptoms or chronic symptoms, when the vesicles were distended and fluctuant and there was an associated moderate or severe prostatic inflammation and the prostatic secretion contained a large amount of pus, we have considered it justifiable to interfere surgically. In a certain proportion of the cases, it will be noted that the vesicle will not empty readily and this may be taken as evidence of a partial or complete blocking of the lumen of the ejaculatory duct or an encapsulation of fluid within the vesicle. This is the type that can be relieved only by operation.

SUPPURATIVE INFLAMMATION OF THE VESICLES

Inflammation of the vesicles exclusive of tuberculosis may be divided into two types: the acute and chronic. With a view as to when operative interference is indicated, the cases have been classified with reference to symptoms.

1. Those in which the pain is the predominating element with inflammatory changes;
2. Those in which rheumatic symptoms predominate; and
3. Those in which vague local symptoms are pronounced, with an accompanying unexplained neurosis.

Cases presenting vague symptoms such as bladder fullness, a feeling of inability to empty the bladder or a sense of incomplete emptying, vesical tenesmus, burning, etc., without residual urine, urethral discharge, or changes in the prostate which are grossly evident, should all be suspected of chronic vesicular infection. Occasionally, if the vesicles are vigorously massaged and found not to empty on pressure, a careful watch of the temperature chart following this manipulation will reveal a slight fever reaction. In this respect it is analogous to the slight fever following vigorous bimanual examination in the female and utilized as a diagnostic sign by the gynecologist when chronic pelvic inflammatory changes are suspected without the presence of tumor.

Guiteras described a feeling of stiffness in the neck of the bladder after urinating as if the bladder wall could not fully contract,

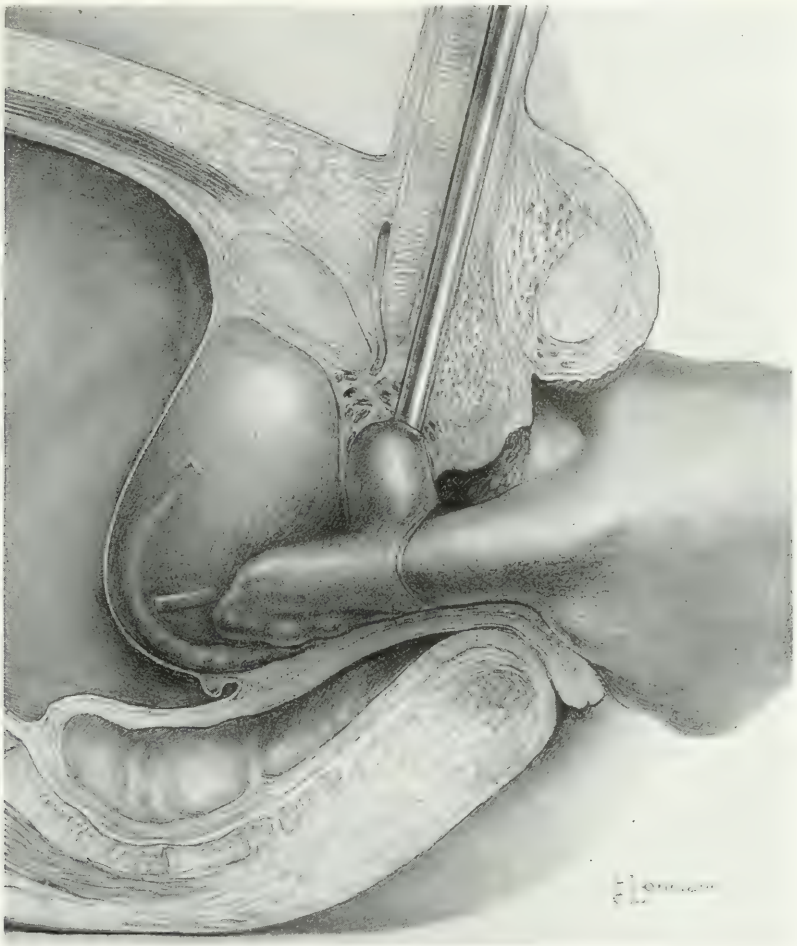


Fig. 3. Showing method of introducing finger beneath second layer of fascia in order to reach tip of vesicle where enucleation should begin.

and he explains this as due to stiffened, unyielding vesicles which extend out onto the bladder wall like a pair of brackets converging to the vesical neck and adherent to the bladder wall. This explains an interesting point in the progress of vesicular inflammation. Occasionally the process is so acute that it extends upward, and the various layers between the vesicle and bladder are obliterated and there is a coalescence of the entire wall of tissue.

Legueu reports a case where extravasation occurred at the site of the vesicles and extended forward along the usual fascial plane, and it was only in radical incision of the perineum that he noted the opening in the bladder at this point. He cites the possibility of this factor being present in other cases of extravasation, and states that abscess formation in the vesicles with destruction of tissue, together with a firm stricture anteriorly, may account for the extravasation.

The cystoscopic examination reveals a well-defined trigonitis in many cases and occasionally the outline of the distended vesicle can be seen showing through the bladder floor. Injected vessels in an area limited by the outline of the vesicles have occasionally been noted. The cystoscopic findings are confirmatory, however, rather than absolutely diagnostic and at the same time explain the bladder symptoms frequently met with and

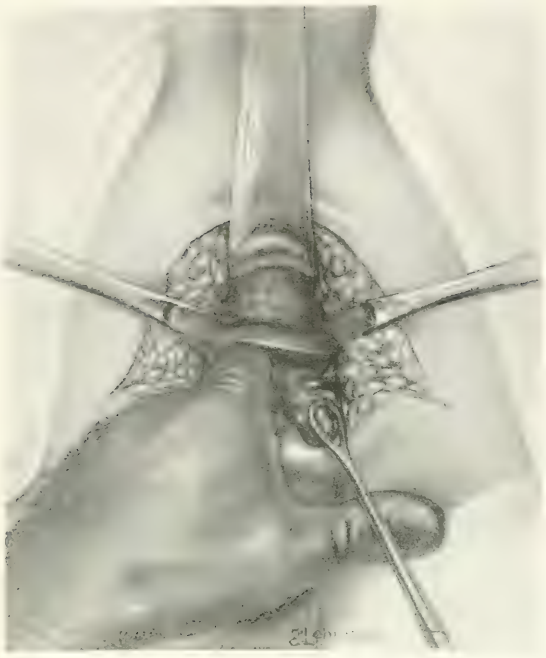


Fig. 4. Enucleation of right vesicle following delivery of left. In most cases the ducts from the vesicles are blocked and they deliver as in the illustration—distended on account of inability to empty. They are tied and divided at their junction with the ampulla.

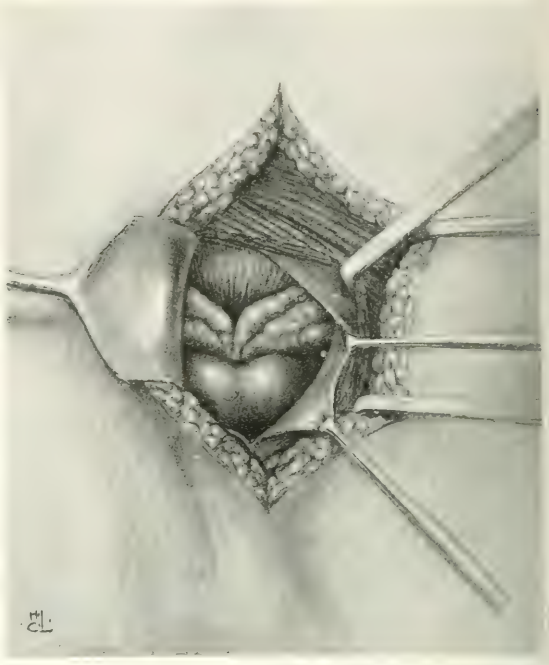


Fig. 5. Exposure obtained in ischiococcygeal method of approach. The levator ani muscles and pelvic fascia are retracted laterally.

already called attention to by numerous investigators.

A typical case history with results from each group is as follows:

TYPE 1

Patient, J. M., age 25, married; three children living and well. Contracted gonorrhœa extramaritally 1 year before, and discharge persisted for 4 months despite all treatment; after 2 months he developed an acute prostatitis with urinary retention. He was admitted to Bellevue Hospital where he remained for 2 weeks. Condition was relieved by hot rectal irrigations and catheterization during the first few days. He returned to work after 1 month and 2 weeks later developed an acute epididymitis. He was readmitted to Bellevue Hospital and treated for 2 weeks without operation. The condition subsided and patient returned to work.

One month later he developed epididymitis on the opposite side with beginning joint pains. He went to private doctor who referred him to New York Hospital. Physical examination showed acute epididymitis on right side, swollen nodular epididymis on left side; general joint pains without local changes; however, bleeding from rectum which was apparently due to a congestion of the rectal mucosa above the prostate and vesicles and not hæmorrhoids. Rectal examination showed prostate swollen, boggy, and moderately tender. Vesicles were enormously distended and fluctuant and would not empty on pressure.

Operation—vesiculectomy. The vesicles were found acutely inflamed and enlarged and left side attached to the bladder base by a firm perivesiculitis which made removal extremely difficult. Both vesicles were removed without rupturing.

Operative convalescence was uneventful; patient was out of bed 5 days after operation. Epididymitis subsided within 4 days, the joint pains disappeared 24 hours after operation. The wound discharged moderately for 11 days. Culture of pus showed colon bacillus; probably a contamination from fæces.

TYPE 2

Emanuel E., referred by Doctor S. H. Meuer, admitted to hospital with chronic urethral discharge and acute gonorrhœal rheumatism. Discharge contained gonococci. The infection was of 6 weeks' duration and joint pains had been present for preceding 3 days. Moderate posterior urethritis was present with marked changes in prostate and particularly in vesicles, which were swollen and distended. Vesicles emptied partially on pressure, and the secretion was composed almost entirely of pus.

Patient treated with vaccine for 2 weeks without results and vesiculotomy then done. Operation was uneventful. The vesicles were exposed in the usual manner and freely incised. Vesicle on left side contained pus which was cultured and reported as staphylococcus aureus. Wound healed well. Operative convalescence was unmarked. Patient complained of muscle tenderness for a short time afterward. Temperature remained on normal level and he has been free from symptoms since that time. Roentgenograms showed no joint changes.

TYPE 3—with Psychosis

J. H. P., married; age 32; gonorrhœa in youth with urethral discharge for usual period and symptoms apparently of posterior urethritis. Patient was married at age of 19 and had two children who are living and well. He developed an acute psychosis in 1913 which had been preceded by spells of nervousness which made it impossible for him to hold a job. He was admitted to the St. Lawrence State Hospital, New York, with a diagnosis of dementia præcox; discharged from hospital June, 1915. He enlisted in the army and was discharged on account of nervous symptoms and readmitted to hospital. No details are given until 1918 when he was found with an acute orchitis, a urethral discharge and an active psychosis. He was unable to give any data concerning himself, and possessed various hallucinations and mental confusion. Wassermann examination of both blood and spinal fluid was negative. No evidence of syphilis or paresis was found. Rectal examination showed a moderate grade of prostatitis with large, distended vesicles, easily twice normal size. Vesiculectomy was done under general anæsthesia. Within 5 weeks patient showed a marked return to normal condition and left the hospital within 10 weeks. Reports from the family state that he is perfectly well and better than he has been for years. He is now employed as a railroad telegraph operator and has no abnormal mental symptoms or neurosis of any sort.

A review of the cases studied shows a similarity in histories to those given above. In all cases investigated a rather remarkable subsidence of symptoms and the consistency with which this is maintained must surely be of import.

PATHOLOGY

Pathological examination of the vesicles removed showed a moderate similarity. Cultures made from the secretions from the vesicles showed varying types of organism. Staphylococcus aureus, staphylococcus albus, bacillus lactus aerogenes, bacillus pyocyaneus, and numerous types of bacillus are noted in the cultural findings. Sectional examination of the specimens yield a variety of findings.

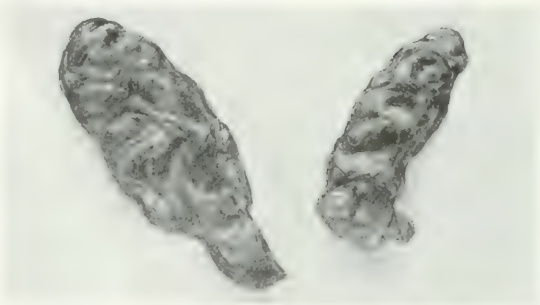


Fig. 6. Types of vesicles removed at operation. Actual size.

When the inflammatory process has extended to the ejaculatory ducts and obliterated the lumen, the vesicles can be usually removed intact. The vesicles are usually two to three times normal size and covered by a firm, fibrous capsule with obvious inflammatory changes. On section the cavities are seen in some cases to coalesce and in others more than one-half the vesicle may be a common cavity, destruction of the interstitial tissues having taken place. Other specimens show an occlusion of the spaces by the development of scar tissue and occasionally numerous small cavities containing a brown inspissated material. Smears made from these show epithelial débris, pus and various types of staphylococcus and sometimes colon bacilli in pure culture.

Following removal of the vesicles there is a marked change in the urethritis and the epididymitis when the latter is present. The discharge usually disappears or changes its character and the epididymitis subsides without the slow rate of absorption generally noted in these cases not operative.

The technique herein described for the operative procedure on the vesicles is, in the main, a combination of the methods devised by Young and Squier, although we feel that our technique contains a number of new features and conservative modifications which contribute largely to the safety of the operation, and are effective in diminishing unfavorable after-results and at the same time aid in a better exposure of the operative field. It is difficult to use the so-called exaggerated lithotomy position without a Young table, and in lieu of this the patient should be

Fig. 7. Chronic discharge; occasional pains; prostate boggy. Fluid contains large amount of pus. Right vesicle tender and distended. Vesiculogram shows a distended, enlarged vesicle without obliteration, however, of intercanalicular areas. Vesicle apparently drains poorly. The tortuous outline of the vas can be made out as it winds around the tip of the vesicle down to the scrotum. The position of the adjacent ureter can be estimated and makes it possible to conceive how extensive perivesiculitis may involve the ureter and produce symptoms in that structure.

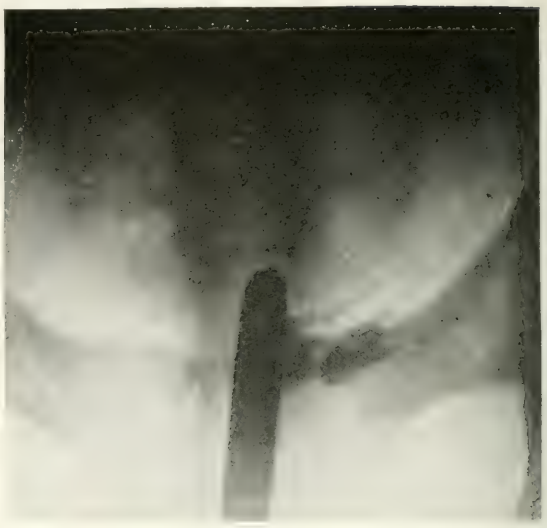


Fig. 8. Vesicle normal in size and appearance, holding the usual amount of fluid. Right side will take scarcely any sodium iodide. Left side fully injected. Outline of vas demonstrable.

brought well forward on the ordinary table and the sacrum elevated from the plane of the table and the buttocks brought out over the edge. This in a way brings the perineum almost parallel with the floor—a great advantage in operative procedure in this field.

A curved incision is then made starting from the ischial tuberosities and continuing through a point which is just superficial to the termination of the bulbous urethra. This point can be determined by palpation of the perineum on a sound which has previously been placed within the urethra. The central portion of the incision should be carried to a depth of at least 1 centimeter. This measure is an important one inasmuch as it provides for better healing of the central portion of the skin flap. In a large series of cases we have failed to obtain a sloughing of the triangular portion at the end as is often seen when an inverted V incision is made. Retraction of the skin flap exposes the sight of the central perineal tendon, and this is divided sharply after blunt dissection of the lateral fossæ on either side. At this point it is important to proceed carefully and retain all the fibers of the bulb in the upper portion of the wound. The thin fibrous line of the central tendon as it converges toward the bulbo-membranous junction can be plainly made out. This obviates a lot of annoying bleeding from the vascular bulb.

The sounds should then be removed from the bladder and the Young seminal vesicle tractor inserted. Traction on this pushes the prostate forward and elevates the apex. By careful sponge dissection, after having previously introduced the finger in the rectum, it is possible to strip away from the apex of the prostate, the well-defined attachments of the recto-urethralic muscle. It is at this point that this muscle becomes prominent and here that one should guard against the danger of injury to the rectum. In observation on numerous operations where the rectum has been injured, we have noted that apprehension regarding the rectum is usually felt prior to this site. It is here, however, that the rectum and prostate are in close apposition and the greatest danger of injury exists.

Gentle tension on the flap with one finger in the rectum then puts these fibers on the stretch, and they can be divided with the

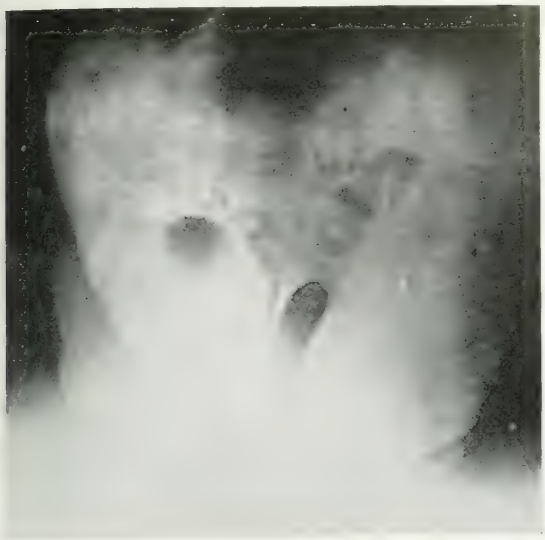


Fig. 9. Showing well-defined abscess of right vesicle. Normal vesicle on left. Outline of vas as it transverses vesicle plainly seen. Tortuous course of vas due to adhesion between vesicle and vas, inflammatory in type.

Fig. 10. Moderate degree of inflammation in the vesicle; note area between vas and vesicle interpreted as limitation of inflammatory process, not involving vas. Outline of the vas plainly seen and course indicated by arrows.

scissors close to their insertion in the urethra. When the rectum has been separated, more than half of the anterior surface of the prostate, the remainder can usually be accomplished by gauze dissection.

The free edges of the levator ani at this point come into view and they can be gently lifted from the posterior surface of the prostate and separation continued by hooking the finger around the free edge of the muscle and further detaching it, after which it can be retracted from the wound.

The posterior surface of the prostate now comes in view, and this should be cleansed of a few adherent fibers of muscle tissue, etc., which have remained from the removal of the rectal wall. This is best accomplished by the handle of a knife and then comes into view the well-defined capsule of Denonvilliers, distinguished by its glistening white color. The prostate is then retracted firmly into the wound and an incision made transversely, at a point just behind the middle axis of the gland. Numerous engorged blood vessels, the latter the result of the vesicular infection, usually can be noted in the tissues, and the incision can be usually varied to avoid these. If sectioned, they give rise to troublesome bleeding. It is at this point that care should be taken to recognize the existence of a special fascial plane covering the vesicles, and after division of the first layer of the fascia, a second layer should be identified and stripped back, in order to reach the vesicles. The tip of the index finger is then inserted anterior to the fascia and along the posterior surface of the prostate and extending outward, and the vesicles can be palpated. Pressure on the organ will sometimes expel a moderate quantity of secretion through the urethra. At any rate the degree of resistance noted is an aid in determining the amount of trauma that can be utilized in removing it. Enucleation is then begun at the tip of the vesicles, and, if carefully performed, the tip will become free. Numerous adhesions are noted to the bladder base, but these can be broken through without difficulty, and further adhesions between the vas, which at this point is directed internally toward the ampulla, are likewise separated. A gauze sponge on a holder, if introduced into the post-prostatic space is often of assistance in drawing the entire structure forward, and the further separation can be completed under guidance of the eye.

Fig. 11. Vesiculogram of case presenting no symptom, chronic prostatitis, hypertrophy of veramontanum, and chronic a. m. discharge. Outline of vesicle well demonstrated. Note adhesion between vas and vesicle at tip of bladder.

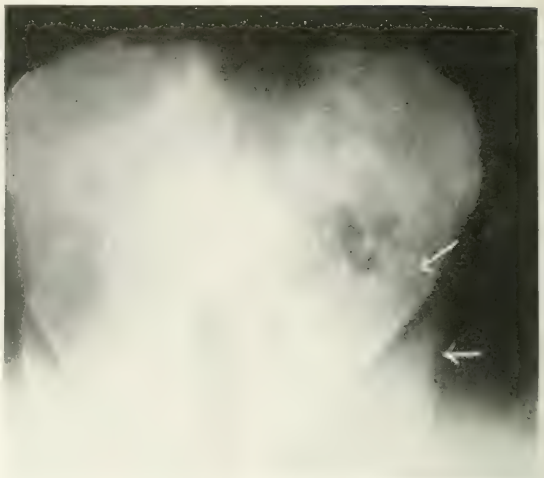


Fig. 12. Showing obliterating type of seminal vesiculitis, where the vesicle has probably been caught in the mesh of adhesion and inflammatory changes, involving likewise the vas. The vesicle can be noted as extending out on the base of the bladder, where it gives a certain amount of fixation with bladder symptoms, due to interference with the action of the trigone. The course of the vas is indicated by arrows.

(Acknowledgment is made to Doctor W. R. Delzell for the use of several of these roentgenograms.)

In vesiculotomy, incision is made in the vesicle at the point where it joins the ampulla and numerous incisions along the axis of the organ. In vesiculectomy the vesicle is crushed at this point and then excised. We have not noted the necessity of ligation although it is not an unwise measure. It is wise to caution regarding the presence of this secondary layer of fascia. In some operative procedures it has been observed that the prostate has been incised too deeply, and when the finger is inserted posterior to the prostate, the vesicles cannot be felt because they have been forced down beneath the level of the finger, together with their fascial coverings.

The prostate is then incised liberally, drainage tubes or wicks inserted at the site of excision or incision, and the prostatic capsule sutured in two places. The sound is then withdrawn from the urethra, and a loose suture placed in the edges of the levator ani muscle and this drawn over the prostate, and the central tendon remitted. No further sutures are taken excepting in the skin which is closed with interrupted silkworm gut, and the tube brought out on each side of the central portion of the wound.

In no case have we noted any severe postoperative complications. There has been no acute retention, and in one case moderate bleeding which was due to incomplete checking of hæmorrhage. If the levator ani muscle is cut instead of retracted and bluntly separated from the posterior prostatic surface, it adds a series of difficulties to the procedure. In the first place, the internal pubic artery branches in this area and the nerve supply is extremely rich, giving rise to immediate or subsequent symptoms. Secondly, it is difficult to control hæmorrhage on account of the position of the muscle. In no case have we noted any severe shock. The patients are allowed to get up on the eighth or ninth day. The sutures are removed in the usual time and the operative care is along general lines.

RESULTS

We will not go into a detailed description of results in individual cases. The histories in the foregoing text furnish good examples

of the results that we have generally had. This does not apply to the mental cases, however, where we have noted about 20 per cent of cures. In the last analysis, we cannot be certain that the infectious focus here was entirely in the vesicles, although in each case the examination showed a large amount of pathology present with definite evidences of infection.

In the pus and pain group, with complicating epididymitis and prostatic abscess, an immediate relief from the pain may be obtained with a more rapid subsidence of the epididymitis and prostatitis than under any form of expectant treatment. If there is a moderate urethral discharge, this will generally be found to be reduced considerably, and in some cases disappear entirely. The prostate generally subsides rapidly from its acute inflammatory condition, and returns to normal size.

In the rheumatic group the results are not observed as quickly. The pain from the joints disappears and usually gives way to vague muscle pains which disappear later. It there are joint changes with periosteal involvement, this can be noted to disappear with a subsequent absorption and increased freedom of joint movement, preceded by earlier cessation of local symptoms, such as pain, redness, and swelling. Cunningham's article on this subject gives an excellent detailed account of the immediate results in gonorrhœal arthritis with accompanying photograph showing resulting joint changes.

In the neurotic cases, including only those types in which the vesiculitis has been determined as the cause of a neurosis apart from disturbed mentality, the results are not so good. We have had relatively few of these cases and the return to normal is not so rapid. The patients worry less, however, about their condition, are reassured by the fact that something has been done for them and can usually find less cause and subjective symptoms to complain of. If these cases are followed carefully, however, it will be noted that there is a gradual improved state of mind and less inclination to worry and concentrate on their condition. Numerous observers have pointed out the tardiness of results in this class and curiously it represents the largest number in whom operation might be indicated.

One disagreeable and questionable complication of a seminal vesiculectomy is the occurrence of sterility following the operation. To be sure if the ampulla has been torn away and the connection with the ejaculatory ducts severed, no spermatozoa will reach the posterior urethra. However, in many cases the ducts are already obliterated and the seminal discharge is without testicular constituents. Other operators have noted a return, however, to normal potency within a 6 months' period, and a variety of conditions regarding sterility. We frankly have not taken occasion to examine for the presence of spermatozoa. We have, however, made careful observation regarding the power of erection and the presence of desire, and we have noted these as early as the first week after operation and on the average within 6 weeks or 2 months. This in our minds removes one rather effective barrier to the further practice of the procedure.

SUMMARY

1. Inflammation of the seminal vesicles is a well-defined and recognized surgical condition occurring usually as a sequel to previous infections of the genito-urinary tract.

2. This condition can be relieved surgically by either drainage or extirpation of the vesicles.

3. Operations on the vesicles combine all difficulties of perineal prostatic surgery and a well-established technique must be employed properly to meet indications for operation. Procedures aiming to drain vesicles through skin incisions, punctures, etc., are ineffective and results reported following inaccurate technique cannot be taken into account.

4. Figures and results in a large series of cases with bacteriological findings and improvement noted in a large proportion of cases justify the establishment of the operation and a more frequent use as a surgical procedure in selected cases.

METASTATIC HYPERNEPHROMA

With Special Reference to Bone Metastasis

By ALEXANDER GIBSON, F.R.C.S., Winnipeg, Manitoba, and J. C. BLOODGOOD, M.D., F.A.C.S., Baltimore

THIS member of the numerous family of the neoplasms is quite one of the most interesting. It is a comparative newcomer, having been introduced to the pathological world in 1884 by Grawitz as *struma lipomatodes aberrata renis*. In 1898, the shorter, more convenient, name of hypernephroma was applied by Birch-Hirschfeld, a name which has persisted and is likely to persist in spite of the fact that it perpetuates what is in many cases a "terminological inexactitude."

EXTRA-RENAL HYPERNEPHROMATA

The great majority of hypernephromata are primary in the substance of the kidney, although they may develop in other regions. Thus it is said that they may exist as primary tumors in the liver. Adami and McCrae state: "A few cases are on record of included adrenal tissue (in the liver) and of tumors, hypernephroma or mesothelioma, originating from the same." Rolleston, in referring to carcinomatous growths in the liver, says: "Schmorl and other writers have established the fact that accessory suprarenal bodies may occur in the liver. The development of a malignant disease in the liver from an included accessory suprarenal body or rest is analogous to the well-known malignant renal tumors arising in suprarenal rests." Stoerk, writing in 1908 in criticism of Grawitz's theory of the origin of hypernephromata, asks the question: "Why, in the face of the legion of adrenal rests found in the liver is there not a single case of hypernephroma of the liver established?" According to Rolleston, Pepere, in 1902, "has given an elaborate account of a primary malignant tumor of the left lobe of the liver arising in a suprarenal rest, which appears to be the first recorded case of its kind." Ewing refers to Pepere's hypernephroma as "clearly an hepatic adenoma." According to Ewing, Schmorl "described a small, yellowish tumor in this region presenting the structure of adrenal cortical adenoma. Larger malignant tumors probably of the same nature are recorded by Vecchi and Noyes." A case is recorded by Chiari of a pelvic tumor which, microscopically, had the structure of a hypernephroma. Operation for removal of this tumor was followed by recurrence and death of the patient. A complete postmortem examination demonstrated that "the tumor was not secondary to a growth in the kidney, suprarenal, or any other abdominal or pelvic organ." (Quoted by Wright.) "The gross and microscopical structure (of Chiari's tumor) was rather typical of adrenal carcinoma." (Ewing.)

A uterine tumor recorded by Eastwood showed typical hypernephroma structure on microscopic examination. This patient lived for some years after operation without hæmaturia or other evidence of the presence of a kidney tumor. Wright states: "Secondary deposits do not usually occur before evidence exists of the primary growth in the kidney." This, however, is by no means an invariable rule, and it is quite possible that this particular instance was a secondary growth.

French reported a case which he described as a hypernephroma arising in the suprarenal quite unconnected with the kidney. In the opinion of Glynn and Wright "the section is not characteristic of hypernephroma."

Glynn, who has studied very extensively the extrarenal hypernephromata, states that they have been recorded as primary tumors in "localities where accessory suprarenals occur, such as the liver, the retroperitoneal tissue, the pancreas, the broad ligament, and even in the ovary and the testicle." In regard to ovarian hypernephromata he states: "It is now generally admitted that ovarian hypernephromata have a closer resemblance to lutein formations than to suprarenal cortex." He is even doubtful if a single case of true ovarian hypernephroma has been recorded. In his opinion many of these growths are luteal. The obvious conclusion is that the micro-

Fig. 1.

Fig. 2.

Figs. 1 and 2. 27929. Bone tumor.—16—Pistory. J.C.B. 10550. Roentgenograms showing lesion in tibia.

Fig. 3.

Fig. 3. 27929. Bone tumor.—16—Pistory. J.C.B. 11550. Gross specimen.

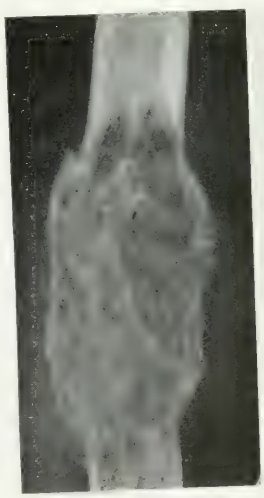
scopic features of hypernephroma are sufficiently variable to make the diagnosis by no means easy.

Rather interesting is the fact established by Glynn and Wilson that tumors of the cortex of the suprarenal, usually referred to as suprarenal hypernephromata, do not correspond to the Grawitz tumor. Wilson records three cases from the Mayo Clinic, and states quite emphatically: "Their cellular structure could not by any possibility be mistaken for any of the pictures found in our series of renal tumors."

Clinically it is found that tumors of the suprarenal cortex frequently induce abnormalities of sex and strength. Renal hypernephromata never, under any circumstances, produce these changes.

A remarkable case of hypernephroma occurring between the folds of the falciform ligament of the liver was recorded by Starr. Among the tumor cells were a few cords of liver cells. The pathological report stated: "The general appearance of the tumor under the microscope more nearly approaches that of a hypernephroma than any other type, but the resemblance is not absolute."

What is the ratio of hypernephromata to all tumors? Wright states that of 10,500 patients at the London Cancer Hospital during 15 years, only 6 showed the presence of hyper-



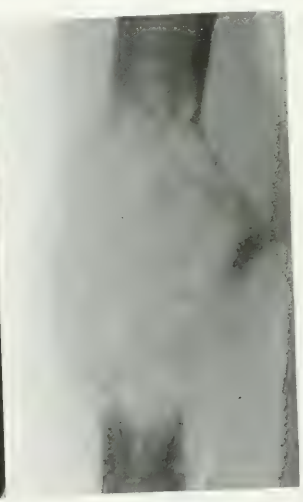


Fig. 4 (at left). 29461. Bone tumor.—10—J.C.B. 11364. Roentgenogram showing central lesion of humerus after healing of a fracture.

Fig. 5. 29461. Bone tumor.—10—Reprint No. 107. Roentgenogram taken some months after Figure 4 was taken. It shows beginning destruction of bone shell.

Fig. 7.

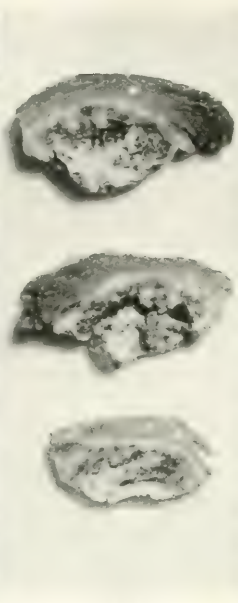


Fig. 6.

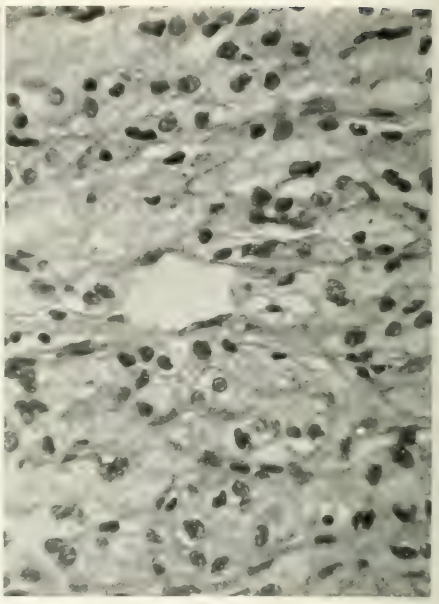


Fig. 8.

Fig. 6. 29461. Bone tumor.—10—J.C.B. 11364. Chambers. Specimen showing tumor occupying bone shell of humerus.

Fig. 7. 29461. Bone tumor.—10—Chambers. J.C.B. 11364. Low power photomicrograph.

Fig. 8. 29461. Bone tumor.—10—Chambers. J.C.B. 11364. High power photomicrograph.

nephroma. This would suggest that the Grawitz tumor is a comparatively rare lesion.

Of kidney tumors, the hypernephroma is much the most frequent. Jocelyn Swan states that they constitute 75 to 80 per cent of all kidney tumors. Pleschner collected 504 cases of which 268 were hypernephroma, 67.4 per cent. Lindstroem, during 43 years, saw 40 malignant tumors of the kidney. Of these 28 were hypernephromata, i.e., 70 per cent. Hyman collected 443 kidney tumors of which 287 were hypernephroma, i.e., 65 per cent. The Mount Sinai Hospital showed 36 hypernephromata out of 38 kidney tumors, almost 95 per cent. Of 92 renal tumors occurring in the Mayo Clinic and recorded by Wilson, 68, i.e., 78 per cent, were hypernephromata.

As regards the age at which these tumors occur, they are for the most part present in late and middle life. Of 28 cases referred to by Hyman, 21 occurred between 40 and 60. One occurred before the age of 10. Scudder re-

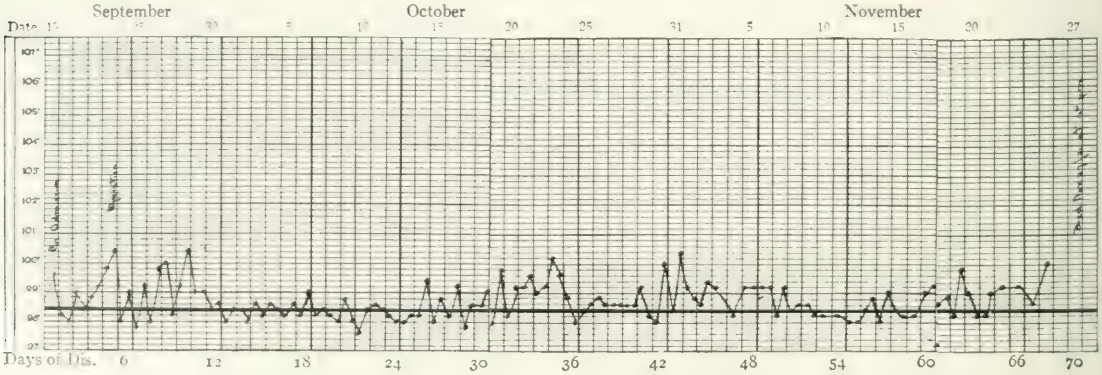


Fig. 9. Temperature chart, case of C.S., temperature being taken at 8 a.m and 4 p.m.

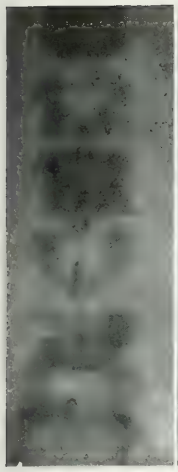


Fig. 10.

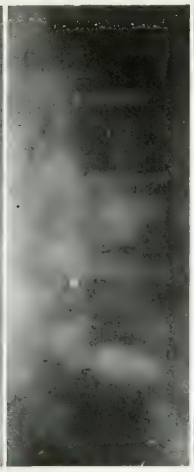


Fig. 11.

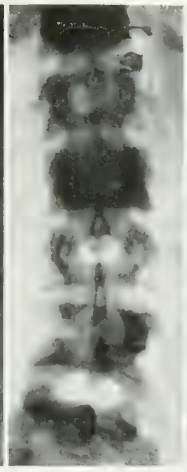


Fig. 12.

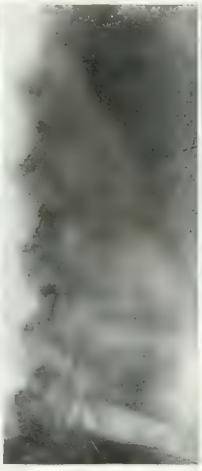


Fig. 13.

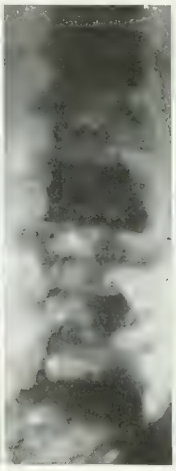


Fig. 14.

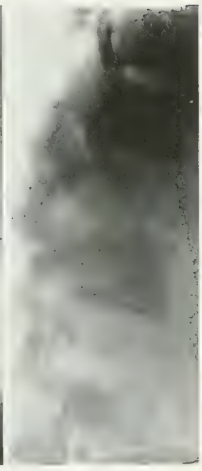


Fig. 15.

Fig. 10. September 7, 1921. Lumbosacral region. Anteroposterior view shows slight excavation at right of body of fourth lumbar. Increased density is seen in second lumbar body. There are nodular masses in right and left sacro-iliac regions.

Fig. 11. September 7, 1921. Lumbar spine. Lateral view shows nothing abnormal.

Fig. 12. September 19, 1921. Anteroposterior view shows marked excavation of right side of body of fourth lumbar. Right transverse process detached. Increased density of second lumbar body. Oblique approximation of third to fourth lumbar.

Fig. 13. September 19, 1921. Lumbar region. Lateral view. Note increased density of second lumbar body.

Fig. 14. October 29, 1921. Anteroposterior view shows first lumbar body much crushed and rarefied; second lumbar body apparently denser than normal; third, fourth and fifth lumbar bodies are mere "ghosts" of vertebræ. Sacrum shows deposits in upper part with destruction of right sacro-iliac joint.

Fig. 15. October 29, 1921. Lateral shows first lumbar body, a crushed outline; second lumbar body apparently dense; third lumbar body represented by a few flakes of bone; fourth and fifth, vague outlines.

corded a case where the first indication of tumor was a spontaneous fracture of the left femur at the age of 75.

What is the frequency of metastasis in cases of hypernephroma? This is a difficult question to answer, inasmuch as many case records are incomplete, and many cases with Grawitz tumors of the kidney remain unrecognized as such, a fair number of such tumors being discovered incidentally postmortem. Further, in the light of experience one may say that no record of these cases is complete which does not include roentgenographic examination of the whole skeleton.

The original tumor seems to be variable as regards its malignancy. Thus Ohlmacher describes two cases "in which the tumors attained considerable size, were well encapsulated, had no infiltrating tendencies, and did not give rise to metastatic formations."

A highly malignant case is recorded by Le Count, and the history of the present writer's case is sufficiently convincing evidence that this tumor is among the most malignant of neoplasms. Wright, in his article, refers to 19 specimens of hypernephroma in 13 of which there were "complete clinical histories," yet not one case of bone metastasis is referred to. In Lindstroem's report the abstract makes no mention of bone metastasis. Hyman's account gives no details of osseous involvement in his cases. Scudder, on the other hand, in reporting 10 cases from the Massachusetts General Hospital, records 4 cases which showed bone metastases. After examination of the literature up to date (1906), he concludes that only 15 authentic cases of bone metastasis in hypernephroma were described.

On the other hand it is generally stated that hypernephroma is definitely a tumor which has bone as a "tissue of predilection" for metastasis, a predilection shared with uterine, breast, thyroid, and prostatic carcinoma. Adami quotes Leuzinger as authority for the statement that in uterine cancer, osseous metastases occurred to the extent of 2.3 to 3.5 per cent, mammary 14 per cent, and 20 to 25

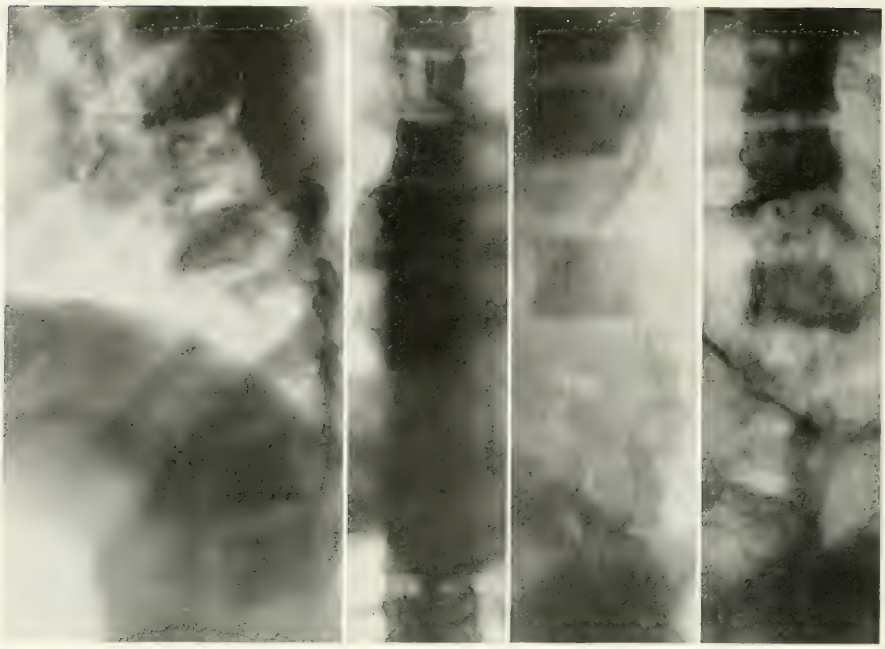


Fig. 16. Fig. 17. Fig. 18. Fig. 19.

Fig. 16. November 27, 1921. Thorax. Lateral view shows indefinite shadows at bases of lungs.

Fig. 17. November 27, 1921. Anteroposterior view of thoracic spine. Metastatic deposit in body of second thoracic vertebra.

Fig. 18. November 27, 1921. Lateral view of lumbar vertebræ. Body of second lumbar is still showing.

Fig. 19. November 27, 1921. Lumbar spine. Wreck of second lumbar is sole survivor of lumbar series.

per cent in thyroid. No figures are mentioned for prostatic cancer or hypernephroma. Kaufmann calculated that about 70 per cent of prostatic carcinomata cause skeletal metastases as compared with 37 per cent for thyroid carcinoma (Limacher) and 14 per cent for mammary cancer. Of 16 cases with skeletal metastases, Kaufmann found more or less osteoplastic tendency in 14 and from the literature he collected 20 cases with extensive growth of bone. Doubtless also cases are met and dealt with as primary bone tumors when the metastasis happens to be solitary, and even when multiple and submitted to microscopic examination, its characteristics as hypernephroma may not be recognized in the absence of urinary findings suggestive of kidney involvement (White). The metastases of hypernephroma, however, are by no means confined to bone. A very interesting and instructive case is recorded by Chance.

The patient, male, age 40, seen in October, 1905, complained of obscuration of sight in the left eye, of 1 month duration. "Beneath the skin of the thorax were several nodular enlargements; in the left groin was a large bubo. Arising from the middle pillar of the iris of the left eye and on the horizontal meridian was a spherical tumor mottled gray in color and approximately 4 millimeters in diameter." A wide iridectomy was performed. The tumor was described as a "perithelial sarcoma." In February, 1906, the eye was enucleated, and the bubo in the left groin removed. The microscopic diagnosis was "small round-celled sarcoma in which are signs of melanotic changes." In April, as an emergency, the abdomen was opened for a double intussusception of the ileum caused by nodules of new-growth. The abdominal viscera were studded with new-growths. Death occurred in May, 1906, after a period of extremely rapid emaciation. Autopsy disclosed "on inner surface of the intestine many tumors varying from 1 to 2 millimeters in size. In the mesentery were a number of enlarged glands and tumor nodules ranging up to 1 centimeter in diameter. None of the abdominal organs contained these tumors except the left kidney. In the envelope of this kidney are 8 or 10 small tumors, the largest about 1 centimeter

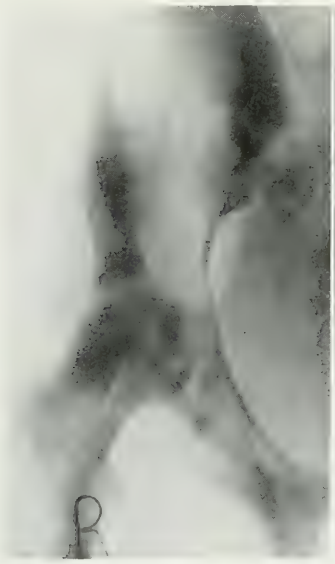


Fig. 20.

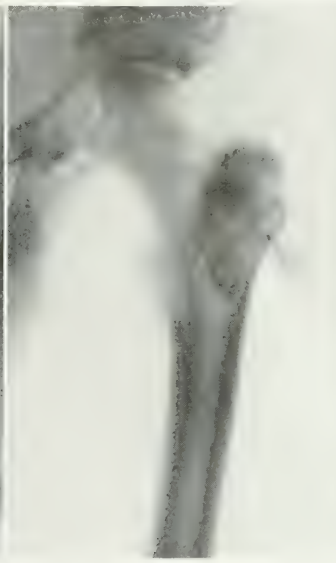


Fig. 21.

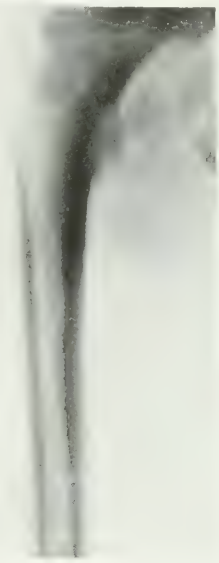


Fig. 22.

Fig. 20. November 27, 1921. Pelvis. Shows destruction of greater part of right ischium. Whole pelvis riddled both sides.
Fig. 21. November 27, 1921. Left femur and pelvis. Nothing below lesser trochanter.
Fig. 22. November 27, 1921. Right shaft of femur. Nothing below great trochanter.

in diameter. . . . . At the lower pole of the kidney and protruding from it, is a rounded tumor about 3 to 4 centimeters in diameter. At the upper end of the pelvis in the substance of the kidney is a smaller mass resembling the larger one." The suprarenals were not affected. There were no nodules in the lungs or heart. Microscopic report was that "the general appearance corresponds with that of a hypernephroma—the alveolar arrangement suggesting the zona fasciculata of the suprarenal." The general conclusion was that the "primary tumor was in the left kidney. Secondary metastases were conveyed by the blood, although the deposits in the mesentery might have been conveyed there by the lymph stream as well as by the blood."

This case is of considerable interest as illustrating the difficulty in interpretation of microscopic findings, a difficulty which will be dealt with more fully later.

Chance refers also to a case published in 1899 by Schlipp as an epithelial tumor of the ciliary body. "Schlipp presumed that he was dealing with an unusual form of endothelioma, but studying his paper in the light of my own case, I am convinced that the tumor he described was a hypernephroma. The patient was a young girl."

In Scudder's series of cases, two are of interest from the point of view of metastasis.

In one, a male aged 75, who fell and fractured his left thigh, a firm, hard, tender mass was observed, attached to the roof of the left orbit. There were many nodules over the body, "one ulcerating mass over the right sternomastoid, and another over the right scapula." No tumor was felt in the abdomen. The urine was normal. At autopsy the report was, "hypernephroma of the right adrenal." Metastases were present in the retroperitoneal tissue, in the intestines, the lungs, liver, pleura, myocardium, brain, subcutaneous tissue in various regions, left orbit and left femur.

A second case, a male aged 33, had observed for 6 years a pimple on the pinna of the right ear. Three years previously it had been cauterized but recurred, and grew rapidly. Abdominal and urinary examination was negative. When seen in January, 1904, he presented "the right ear lobe and cartilage changed to a foul sloughing and bleeding mass. Enlarged glands were present on the right side of the neck." The ear was removed and a dissection of the right side of the neck was performed. Microscopic report was, "a lobular growth of large round cells with little intercellular substance. Diagnosis: round-celled sarcoma." In May, 1904, he was readmitted to hospital. The wounds of the ear and neck had healed. He had lost 30 pounds in the preceding 3 weeks. In June, 1904, he died. Complete autopsy showed "hypernephroma with metastases in intestines, stomach, great omentum, mesocolon, retroperitoneal tissue, pancreas, peritoneum, right groin, right shoulder joint (upper end of right humerus), subcutaneous tissues of the trunk, and brain."

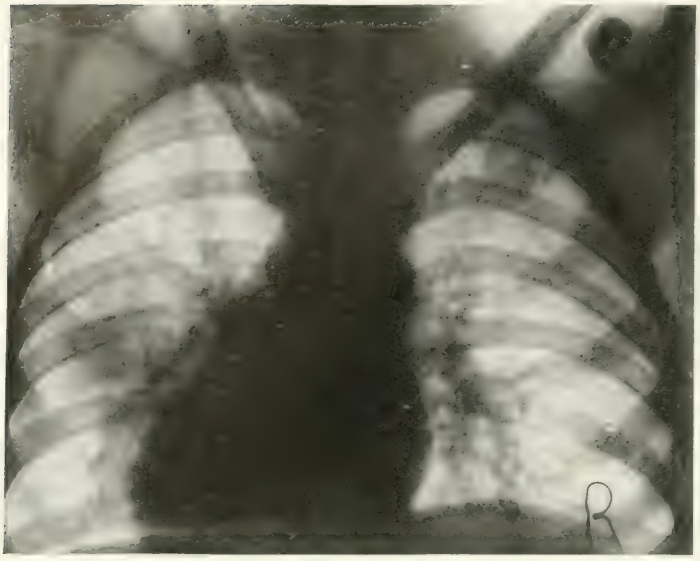


Fig. 23. November 27, 1921. Thorax and lungs. Anteroposterior view shows shadows suggestive of metastases. Really pneumonic consolidation.

Fig. 26. November 27, 1921. Right shoulder and humerus. Ribs, head and shaft of humerus.

In this case record, one point of interest is the long duration of the growth in the pinna with apparently low grade of malignancy.

Fig. 24. Fig. 25. Fig. 27.

Fig. 24. November 27, 1921. Left shoulder. Deposits in scapula and surgical neck of left humerus.

Fig. 25. November 27, 1921. Hands and forearms. Nothing below elbow.

Fig. 27. November 27, 1921. Below knees, nothing.

Interesting also, though far from unusual, is the fact that, for a very long time, the metastasis, not the primary growth, was the only indication of the real lesion. Further is the fact that when an increase in malignancy did occur, the progress was extremely rapid. This fact also has been frequently noted. In this case also the difficulty of diagnosis from a microscopic section of the secondary growth is apparent. Sarcoma, the cells being grouped in alveoli, is a common report on metastatic hypernephroma.

Other situations in which secondary growths have been recorded are the base of the tongue (Coenen), the left ventricle of the heart (Batzdorff), the nasal cavities (Storath). Channing and Knowlton describe a case of "metastatic adrenal tumors in the left midfrontal and ascending frontal convolutions." There is apparently no tissue or locality of the body which is not susceptible of being the seat of secondary deposit. The general opinion, however, is that expressed by Lilienthal: "In the experience of the writer, by far the commonest location of the metastases is in the bones, and especially in the flat bones." Exception might be taken to the last phrase.

OSSEOUS METASTASES

The bone metastasis may be single or multiple. It may be the first indication of the presence of the tumor. A certain number of them are revealed by spontaneous fracture. Thus, Bevan relates the case of a child who, while playing at school, felt something snap in the hip. X-ray showed fracture of the upper end of the femur (right). The child died later, almost the whole skeleton being extensively involved.

In some cases pulsation is a pronounced feature of the bony involvement. Eshner describes a case involving the sternum where the condition was mistaken for an aneurysm of the aorta.

The patient, a woman aged 60, presented a tumor of the manubrium sterni yielding evident pulsation synchronous with the heart and having an expansile character. At autopsy was found "over the manubrium sterni a small lemon-sized tumor of soft consistency which on incision exhibited a grayish color. This was found to involve the entire manubrium and the cartilage of the first and second ribs at their junction with the sternum. The right kidney contained at its lower pole, close to the pelvis, a new-growth 4 to 5 centimeters in dimensions, the uterus at its fundus contained two small chestnut-sized growths. On histological examination the growths in the kidney, lung, uterus, and sternum exhibited the structure of hypernephroma."

White describes a case of multiple pulsating tumors of bone, the growths occurring in the os calcis, the tibia, and the femur. Amputation was performed through the middle of the thigh.

The pathological report was that "the essential part of the tumor consists of masses of cells arranged as solid acini and bounded by delicate capillary vessels. In parts the structure suggests an epithelial growth; other parts suggest a malignant, vascular tumor. A fuller study of the less altered and apparently freely growing areas leads one to the view that it is a sarcomatous formation corresponding to the usual description of 'alveolar sarcoma.'" In spite of the lack of references to abdominal tumor or hæmaturia, the *tout ensemble* of this case is very suggestive of metastatic hypernephroma.

When incised, the osseous metatasis shows the characteristics of a soft, highly vascular tumor; "soft, yellowish material, not unlike a gumma" (Warren Low); "soft, highly vascular, plum-colored growth studded with sulphur-colored nodules" (Nitch); "the tumor is light red in color, mottled with darker red areas of hæmorrhage and has a delicate white reticulum throughout." Evidently the bright yellow areas so characteristic of the primary renal tumor, are not always reproduced in the secondary growth. The tendency to hæmorrhage and necrosis is usually well marked.

Fig. 28. Skull and upper cervical spine shows no deposits in skull; destruction of second cervical vertebra.

As regards the X-ray findings, these may be summed up as resembling those of a central sarcoma of the bone. There is never any production of new bone; the cortex may be expanded, there is usually rarefaction of bone in the neighborhood, and the metastatic shadow tends to be circular in outline. There are no roentgenographic findings which differentiate hypernephroma from any other form of skeletal carcinomatous metastasis. Risley states that metastasis occurs probably by centrifugal spread along the lymphatics of the deep fascia in most cases. While this is true for malignant breast conditions, it is almost equally certainly incorrect for hypernephroma. He

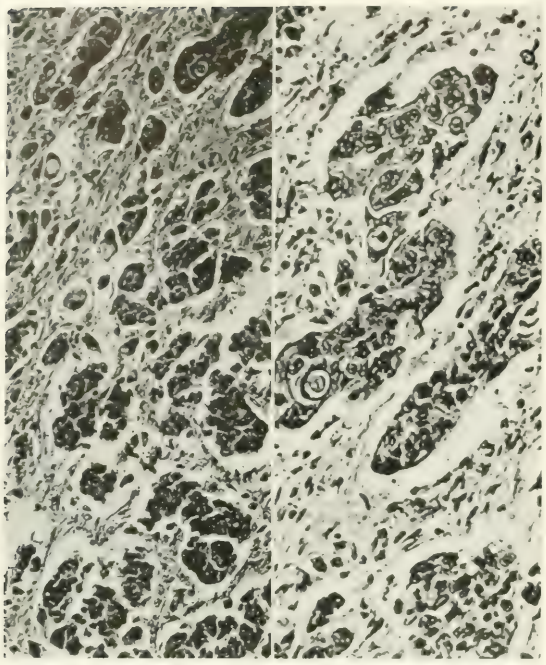


Fig. 29 (at left). Section of tumor tissue, low power.
Fig. 30. Section of tumor tissue, high power.

further states that bone metastases occur almost entirely proximal to the elbow and knee-joints. This occurred in our own case but is not invariable (White, Pool). As regards the method of metastasis to bone, this is probably in the great majority of cases by blood stream rather than by lymph channels. Hypernephromata have a notorious tendency to grow into the veins, cases being recorded where the tumor growth has extended along the renal vein to the inferior vena cava, and even up to the right heart. The liver is a fairly common site for metastatic growths and it is supposed that dissemination occurs by retrograde embolism along the portal vein from the inferior vena cava. MacCallum does not agree with this view and holds that the tumor cells are implanted in the liver after traversing the pulmonary and systemic circulations. In face of the frequency of vascular involvement, it is surprising that the development of a bone metastasis may be delayed. Thus Clairmont describes a case in which death occurred from metastasis in the chest 10 years after operation on the primary tumor. A patient of Albrecht's died 7 years after nephrectomy. Ewing attributes this occasional slow development of the metastasis to phlebitis which blocks the progress of the tumor cells. Fischer reported metastases 6 years and 9 months after nephrectomy; Kroenlein 6 years and 11 years afterward (Trotter). It is of interest and importance that the bony metastasis may be the sole metastasis (Albrecht, Scudder). It would seem at first sight to follow from the vascular dissemination of the tumor that metastatic deposits in the limb bones would be found nearest the entrance of the nutrient arteries. This is not always the case. They are frequently found near the extremities of the bones. This is probably due to the fact that malignant cells in the blood stream tend to fall out of the blood current and settle in the tissues where the caliber of the vessels is smallest, and where the flow is most retarded, as occurs in invasion by organisms in cases of osteomyelitis. These conditions are more probable at the extremities of the bones than in the shaft.

Lymphatic dissemination undoubtedly occurs in some cases. Le Count's patient showed involvement of the inguinal glands; a case recorded by Bierring and Albert, a child aged 5, showed marked involvement of the retroperitoneal glands. The distribution of secondary growths in the case described in this paper suggests lymphatic rather than hæmic dissemination.

Implantation directly on to peritoneal surface is another method of spread, and theoretically, at least, the lower urinary passages might be "infected" by cells from the kidney (Bierring and Albert).

Microscopic characters of the osseous metastases reproduce more or less the characteristics of the primary growth. While in many cases the cells are definitely epithelial in character, in very many others they resemble much more the undifferentiated connective-tissue cells so that they are more frequently described as sarcomatous than carcinomatous. They are often arranged in distinct alveoli; hence the concise report of "alveolar sarcoma" so frequently given. There is usually a small amount of intercellular substance; large-sized cells and mitotic figures are com-

mon. Adami states: "On careful study we can make out the transition from the purely adenomatous to the alveolar sarcomatous areas; and from these areas we may pass to regions of purely sarcomatous type, round or even blunt spindle-celled. The picture is an extraordinary one, wholly at variance with the older views of the 'sanctity' of sarcomatous and carcinomatous properties. Here, absolutely without any manner of doubt a tumor shows transition from sarcomatous to carcinomatous characteristics." It is chiefly on this account that Adami describes these tumors as mesotheliomata.

In reviewing the literature, one is struck with the confusion that exists regarding the primary tumors. Many writers accept without question Grawitz's hypothesis as to these tumors. This probably accounts for some reports of tumors being found in the adrenals when the actual tumor may have been in the upper pole of the kidney. The question at once suggests itself, can suprarenal tumors—not Grawitz's tumors—form bony metastases? On this point, Ewing states: "The frequency of bone metastases in tumors of supposed adrenal origin has long been emphasized, but in most of the reported cases the tumor arose in the kidney and the exact nature was not fully determined. In cases of fully verified adrenal carcinoma bone metastases are infrequent. They occurred in three of Winkler's 10 cases. In 48 cases of various malignant adrenal tumors collected by Hartman and Lecene bone metastases were demonstrated in only 1, while the liver was involved in 23; lungs, 9; pre-aortic nodes, in 8; peritoneum, 5; stomach, pancreas, heart and brain occasionally." It is much to be desired that a distinction should be clearly drawn between "renal hypernephroma" and "suprarenal hypernephroma."

According to Ewing there would seem to be at least three classes of tumors which are at present subject to the diagnosis of hypernephroma:

1. Adenocarcinoma of the adrenal cortex;

2. Hypernephroma arising in the kidney from adrenal rests;

3. Renal adenocarcinoma, papillary or alveolar, arising in the kidney from kidney cells.

In the adrenal adenocarcinomata, bone metastases are infrequent; in the true hypernephromata not very frequent; much the most frequent in the renal adenocarcinomata. Another form referred to by Ewing is a "diffuse infiltrating carcinoma of the kidney, the organ being much enlarged but not greatly deformed, which probably originates as papillary carcinoma of the pelvis. Metastasis was observed in Kischensky's case in the femur."

It is worth while to mention at this point the neuroblastomatous tumor arising as a neoplasm in the medulla of the suprarenal gland, and giving metastases in various parts of the body, mainly in the orbit and cranial bones. These tumors, first described by Robert Hutchison in 1907, occur in childhood, and are not likely to be confused with hypernephroma. They are essentially derivatives of sympathetic nerve tissue. The proptosis which is a fairly constant feature in recorded cases should suggest the diagnosis in a very young subject.

The dispute as to the derivation and character of hypernephromata will probably be pursued by the pathologists for some time to come. Up to the present, the variations in opinion, though always interesting, are irreconcilable with the idea that "hypernephroma" is a single pathological entity. Consideration of the divergent views is outside the scope of this paper.

Dr. J. C. Bloodgood of Baltimore has very kindly furnished a summary of all cases of hypernephroma that have come under his notice during the last 16 years.

SUMMARY OF METASTATIC TUMORS TO BONE FROM HYPERNEPHROMA—SURGICAL PATHOLOGICAL LABORATORY, JOHNS HOPKINS HOSPITAL

Total number of cases 8. From July, 1906, J. C. B. 1415, to December, 1922, Path. No. 31887.

The total number of bone lesions is about 1,000.

Brief summary: J. C. B. 1415, July, 1906, Dr. W. G. Clark, of New York, reports a metastatic hypernephroma of the head of tibia. No tissue received.

Path. No. 6299, February, 1906, autopsy Johns Hopkins Hosp. 2534. White male, age 52, had sciatic pain in left side for 18 months. He had been confined to bed 6 weeks, and had been using crutches on account of pain in leg 15 months. Tumors in

scalp had been present 1 year. Autopsy showed hypernephroma with metastasis to sternum, femur, and rib. The metastatic tumor in the femur shelled out. The bone shell was almost completely destroyed. On incising the tumor much blood was found. The section resembles the tumor in the kidney. Restudy of sections to date shows that the tumor was cystic and the cysts are lined by cells not unlike the hypernephroma.

Path. No. 6930. This case is reported by Scudder in the *Annals of Surgery* for December, 1906, xliv, 851. The tumor occupied the upper end of humerus. The bone shell was expanded and very thin, and the sections were typical of a hypernephroma. My original tissue and sections have been lost. This patient was operated upon by Scudder in September, 1905. Amputation of shoulder girdle type was done. No note that the kidney tumor was removed. Scudder wrote me, 1909, 4 years later, that the patient was living. Sometime later the patient died. Details not given. This case is, therefore, interesting because of the long life after removal of the metastatic tumor.

Path. No. 27929. April 16, 1921, Joseph Pistory. Material sent by Dr. Walter G. Stern, Cleveland, Ohio. Central tumor upper end of tibia with partial destruction of bone shell to the inner side. Treatment: amputation February 26, 1921. Microscopic sections, Bloodgood: hypernephroma. Result: Death December 13, 1921, 10 months. Before death there was evidence of metastasis to the vertebræ. Patient was a male, age 29, Italian. No symptoms referred to the kidney. He had had pain in tibia 8 months. Figs. 1 and 2 are roentgenograms of the lesion of the tibia. Figure 3 shows the gross specimen. This case was diagnosed large round-cell sarcoma. We have no proof that it was a metastatic hypernephroma excepting the sections and the evidence of other bone metastasis before death.

Path. No. 29397. December, 1921. Material sent by Dr. Alexander Gibson. Sections very suggestive of hypernephroma. Fully reported in this paper.

Path. No. 29461. Patient of Dr. W. H. Bachman, McKeesport, Pennsylvania. Reported to Dr. Bloodgood April 3, 1922. Published by Bloodgood, *Minnesota Medicine*, 1922, v, 604, Fig. 4. Figure 4 is the first roentgenogram, showing the central lesion of the humerus after the healing of a fracture. Figure 5, some months later, shows beginning destruction of the bone shell. Figure 6, the tumor occupying the bone shell of the humerus. Figure 7, microscopic, low power, and Figure 8, microscopic, high power. It is interesting to note that the day this section was studied we had a section from a primary hypernephroma of the kidney from another individual, and it was practically impossible to distinguish one from the other. The roentgenogram (Fig. 4), of this case is rather typical of the hypernephroma. The fine dark lines give the light area a spongy appearance, as if the roentgenogram had been taken through a screen. Clinical note: W. F., 65. Fracture of humerus. Roentgenogram 12 weeks later (Fig. 4). At this time X-ray examination of skeleton showed no other bone lesion. No Bence-Jones bodies. No evidence of kidney tumor. Three months later second X-ray examination (Fig. 5), shows destruction of the bone shell. Patient suffers great pain in the arm. Urine contains Bence-Jones bodies. X-ray examination of skeleton is negative. Considered multiple myeloma. The patient became bed-ridden with pain. April 15, 1922, amputation was done because of pain. Now the microscopic section shows a hypernephroma. Further result not ascertained.

Path. No. 30631. Johns Hopkins Hospital, June 17, 1922. Metastasis in frontal bone. Through exploratory incision a piece of bone was excised and microscopical examination showed metastatic hypernephroma. The X-ray examination showed destruction of the left frontal bone. The metastatic tumor rested on the dura. No positive evidence of a kidney tumor was present, but before the patient left the hospital there was a palpable tumor in the right kidney with hæmaturia.

Path. No. 31887. December, 1922. Sections sent by Dr. Schade, Toledo, Ohio, without data except metastatic bone tumor, which Dr. Schade correctly diagnosed hypernephroma.

The following case of multiple tumors of bone came under my care:

C. S., student, aged 20, was admitted to Winnipeg General Hospital on September 6, 1921, complaining of pain in the lumbosacral region radiating along the inner aspect of both thighs; also of numbness along the inner aspect of both thighs.

Previous illnesses. Tonsils and adenoids removed in 1911; appendix abscess in 1916. In May, 1921, he was operated on for recurrent dislocation of the left shoulder, a flap being transplanted from the posterior border of the deltoid, through the quadrilateral space to the coracoid process. Otherwise he had always been a strong, healthy boy. In 1921 he was athletic champion of his college. He took part in all sports, especially boxing and baseball.

Present illness. Began after an injury on July 20, 1921. The injury consisted of a wrench to his back while lifting a large bag of potatoes on his shoulder and then into a dining car. The discomfort was mild at first, but had gradually been getting worse, until he was hardly able to bend forward. In the beginning of August he went to work attending a gasoline engine. This involved cranking the engine. He found that this action caused a return of the pain in his back, and it now began to radiate down the anterior and inner aspect of both thighs as low as the knees. Since the beginning of September there had been tenderness in the lumbosacral region. He had also noticed that if he stubbed his toe while walking he experienced a severe pain in the lower part of the back. The pain had gradually become

worse. Bowels had always been regular; occasional attacks of diarrhœa when in camp. No gastric trouble. No history of cough. No venereal disease. No urinary symptoms. I was asked to see the patient on September 21, 1921.

On examination, it was barely possible to recognize the strong man of 4 months previously. He was pallid, emaciated and haggard, complaining of constant severe pain down the front and inner side of the right thigh. Urine examination gave no abnormal findings. The Wassermann report was negative. Blood examination showed: hæmoglobin, 55 per cent; red blood cells, 3,788,000; anisocytosis, slight; color index, .75; leucocytes, 12,800; polymorphonuclears, 86 per cent; small lymphocytes, 14 per cent.

A roentgenogram of the lumbar region taken September 7, 1921, had been reported as showing no abnormality. A second roentgenogram was taken on September 19. It showed definite curvature of the lumbar spine, loss of substance on the right side of the third lumbar vertebra with detachment of the right transverse process. The outline of the right psoas muscle was not clear. Opaque masses were observed overlying the right and left sacro-iliac regions, but their significance was not appreciated. Two possibilities were considered: (1) tuberculosis and (2) sarcoma.

Against tuberculosis was the extreme pain and the very rapid cachexia. Against sarcoma was the extreme rarity of the condition. There was no suggestion of a primary lesion in the thyroid or prostate, and the negative urinary findings did not direct one's thoughts to the kidneys. With the diagnosis of tuberculosis, a spinal fusion operation was performed on September 23, 1921, the vertebræ dealt with being the second, third, fourth, and fifth lumbar, and the sacrum. Patient stood the operation very well and for a week or two slept better and was more free from pain. Thus the report for September 28 and 29 is: "Not complaining of any discomfort." September 30: "Very comfortable; no pain, but unable to sleep." On October 17, for the first time since operation, he complained of some pain in the right thigh. For the next few nights he did not sleep well. On October 20 a swelling was noticed in the right Petit's triangle, and was demonstrated to a colleague as a typical lumbar abscess. As the swelling continued to increase in size it was aspirated on October 26. Pure blood was drawn off. Microscopic examination failed to disclose tumor cells. However, in view of the fact that pure blood was obtained, the diagnosis reverted at once to sarcoma, and patient was again roentgenographed. The amount of destruction that had occurred in the month since operation was staggering. From this time until death occurred patient's condition steadily deteriorated. Morphia was given freely, the one indication being to keep him as comfortable as possible, and to do without moving him lest he literally break in two. Patient's appetite failed and emaciation became extreme. Paralysis of the right lower limb soon became complete, and this was followed speedily by paralysis of the left lower limb. The lumbar swelling increased very considerably in size; it became hot, rather tender, with dilated veins over the surface. Pain referred to the right lower limb was almost constant. He developed considerable difficulty with bladder and bowels, owing to the severe pain associated with the slightest movement, and the matter of nursing became extremely difficult. This was accentuated by profuse perspiration, probably associated with the administration of morphia. On November 3, 1921, a very large mass was palpable in the right iliac fossa. From this time onward pain was complained of in the neck, in the upper limbs, abdomen and lower limbs. Both lower limbs became markedly œdematous. Death occurred on November 27, 1921. The temperature chart (Fig. 9) shows the degree of fever.

After death a complete roentgen-ray examination was made. This showed widespread bony metastases as illustrated in accompanying photographs. A postmortem examination was made by Dr. William Boyd. His report follows:

Clinical diagnosis: sarcoma of spine. Surgeon in charge: A. Gibson.

External examination. The body was profoundly emaciated, and the face appeared to be that of a man of 40 rather than a boy of 20. Over the sacrum there were recent bedsores, and to the right of the lower lumbar vertebræ there was a soft, apparently cystic swelling, 3 inches in diameter.

Inspection of cavities. The *spine* was exposed throughout its entire length, both on its anterior and posterior surfaces. Three distinct tumor masses were found. The first was an enormous mass growing from the lower lumbar vertebræ, and already noticed on external examination. The second was an elongated swelling, 1 inch in length, and situated on either side of the dorsal aspect of the second dorsal vertebra. It was yellowish white in color, and of the consistency of hard butter. The third was situated in a similar position in relation to the second cervical vertebra. It was 2 inches long, and of the same consistency as the second. Both of the latter growths were closely incorporated with the bodies of the vertebræ.

The tumor in the lumbar region merits further description. It was a huge, soft, fluctuating mass which surrounded the bodies of several of the vertebræ in front and appeared on either side of the spine behind. It contained an immense quantity of thin, bloody, grumous material, which readily flowed away when the mass was incised. The bodies of several of the vertebræ were incorporated in the mass and completely destroyed. The cut surfaces showed a ragged mass of dark-red granular material, in which numerous but definite bony masses could be felt. One part, less necrotic than the rest, displayed on section a mass of telangiectatic cavities filled with bright red blood.

On the third rib on the left side, 2 inches from the middle line, there was a soft elongated mass 1 inch

SUMMARY OF CASES OF BONE METASTASES ON RECORD

Cases 1–15 are recapitulated from the article by Scudder

	Author	Sex	Age	Bones	Remarks
1	Albrecht	?	?	Skull	Diagnosed as sarcoma.
2	Albrecht	?	?	Occipital bone	Nephrectomy 4 mos. before. Death 6 mos. later. No other metastasis.
3	Albrecht	F.	60	Left femur	Spontaneous fracture, amputation 5½ yrs. later, kidney tumor. Urine always negative.
4	Albrecht	M.	42	Frontal and temporal	Hypernephroma at autopsy. Urine contained albumin.
5	Albrecht	?	48	"Knee-joint"	Amputation. Death. Hypernephroma. Urine contained some leucocytes.
6	Albrecht	F.	66	Clavicle	Hypernephroma. Diagnosed tuberculosis. Urine contained a few leucocytes.
7	Loewenhardt	?	?	Clavicle	
8	Von Bergmann	?	?	Tibia	Pulsating tumor.
9	Israel	?	?	Rib, thigh	First signs of disease.
10	Kuster	?	?	Calvarium	First sign.
11	Kuster	?	?	Rib	First sign.
12	Scudder	M.	34	Humerus	Amputation. Urine normal. Diagnosed sarcoma.
13	Scudder	F.	40	Left frontal, right parietal, left humerus	
14	Scudder	M.	75	Left femur	Hypernephroma of right adrenal. Multiple metastases.
15	Scudder	M.	33	Right humerus	Hypernephromata both adrenals. For 6 yrs. metastasis in pinna. Marked terminal cachexia.
16	Storath	?	?	Nasal cavity	Pulsation.
17	Eshner	F.	60	Sternum	Diagnosed as aortic aneurysm.
18	Bland-Sutton	M.	45	Humerus	Diagnosed as myeloma—excision. Recurrence 2 years later. Death 5 years later.
19	Warren Low	M.	55	Clavicle	Spontaneous fracture. Death "a year or two afterward."
20	Nitch	M.	52	Ulna, rib	Upper third of ulna. Diagnosed tuberculosis. Growth recurred to original size in 6 months.
21	Nitch	F.	?	Right humerus, left scapula	Diagnosed sarcoma. Secondary to adrenal carcinoma till then unsuspected.
22	Nicholson	F.	19	Tibia	Two years later, recurrence with palpable abdominal tumor.
23	Bevan	F.	Child	Femur	Spontaneous fracture. Death with "almost entire skeleton involved."
24	Macleod and Jacobs	M.	51	Sternum	Pulsation. Tumor size of orange.
25	Macleod and Jacobs	M.	69	Sternum	Tumor 3½ by 6 inches. Tumor in left kidney.
26	D'Agata	M.	56	Parietal	Size of hen's egg. Growth rapid.
27	Bullowa	M.	65	9th and 10th thoracic vertebræ	Tumor in back. Pure blood. Transverse myelitis. Autopsy: Tumor left kidney size of tennis ball.
28	White	M.	28	Os calcis, tibia, femur	Marked pulsation. Diagnosis: Alveolar sarcoma.
29	Le Count	?	?	Ilium, sacrum, femur	Highly malignant.
30	Garrow and Keenan	M.	49	10th and 11th thoracic vertebræ	Grew into spinal canal. Practically no urinary symptoms.
31	Affleck and Leith	M.	46	Sternum ribs	Glands involved. Thrombosis of vena cava inferior.
32	Pool	M.	57	Fibula and tibia	Emaciation. Diagnosed as sarcoma. No kidney symptoms till later.
33	Mouisset and Chalier	F.	24	Occipital, body of sphenoid.	(Quoted by D'Agata.)

in length, which, when incised, was found to contain masses of lime salts.

The heart, liver, spleen, pancreas, adrenals, stomach and intestines showed no abnormality.

The *lungs* were of normal size and color. On section numerous small irregular areas could be distinguished with great difficulty, but were readily detected by the palpating finger. Their consistency was very soft.

The *kidneys* were of normal size, but on section the cortex was swollen, pale and fatty looking. The medulla appeared normal.

The *bladder* was greatly distended, and scattered over the surface of the mucosa were numerous small bright red hæmorrhagic areas.

Report of sections. (*1.*) *The tumor of the spine.* The greater part of the section is made up of blood clot. Around the periphery of the clot there is a zone of cells. These cells are large epithelial-like cells with an abundant cytoplasm and a large vesicular nucleus. They are arranged in definite clumps or solid acini separated by a scanty, although quite distinct, fibrous stroma. The cells are of fairly uniform size, but some are considerably larger, and almost merit the name of giant cells. Mitotic figures are fairly numerous. It is evident that this is not an example of sarcoma of bone. The cells are epithelial in type and most definitely epithelial in arrangement. It appears to be secondary growth from some carcinoma which was not discovered at the autopsy. The cells have not the clear or slightly foamy cytoplasm so characteristic of a hypernephroma.

2. Growth from shoulder. The appearance is similar to that just described except that no blood clot is present. The masses of epithelial cells are very definitely elongated and in places almost columnar. Vascularity is very marked but the cells are not grouped around the blood vessels in any particular arrangement. Small pieces of bone are seen here and there.

3. Tumor of the rib. The appearance is identical with that just described.

4. Lungs. The small nodules in the lung which were thought clinically to be metastatic in nature are in reality areas of pneumonic consolidation. The alveoli are filled with cells mainly mononuclear together with a few threads of fibrin. The blood vessels were moderately dilated.

The roentgenographs and microscopic sections of the tumor tissue were submitted to Dr. J. C. Bloodgood of Baltimore. He very kindly reported as follows:

"The patient is a male, age 20. This practically excludes primary carcinoma of breast, thyroid, and prostate, but at this age we might see hypernephroma, cancer of the intestine, and periosteal sarcoma. . . . The tumors of the vertebræ that are associated with hæmorrhage are the giant cell—the perithelial angiosarcoma—and the hypernephroma. I would not expect it in metastatic carcinoma of any type. . . . Primary sarcoma of bone rarely metastasizes to bone. Histologically this is not a multiple myeloma. It seems to me that it must be looked on as a metastatic hypernephroma."

The roentgenographs taken after death show the widespread bony involvement. There is apparently no metastasis in the skull, but the second cervical vertebra is practically destroyed. In the thoracic region there is only equivocal evidence of secondary growth in the vertebral bodies though it is clear enough in one of the ribs.

The lumbar region of the vertebral column is most interesting. From the very beginning the second lumbar body seemed distinguished by greater density than normal, and to the last it has resisted infiltration more than the others, though the first above it and the third below are so destroyed as not even to be recognizable as ghosts of their former selves. This resistance of the second lumbar body is very noteworthy.

The sacrum and pelvis are so riddled with growths that no detailed description is possible. It is also rather remarkable that the limbs should have escaped involvement to the extent they have done. In both upper limbs the lowest limit reached is the upper third of the shaft of the humerus. In both lower limbs there is no involvement lower than the level of the lesser trochanter of the femur. This distribution of the metastases is much more suggestive of a lymphatic than a hæmal distribution.

The manner in which bony tissue has melted like snow before the sun is very striking. It suggests strongly that some fairly strong acid medium has been in contact with these bones. So far as I am aware no observations have as yet been made upon the hydrogen-ion content of tissue fluids.

Of malignant conditions which may manifest themselves in bone, it is impossible that any epithelial growth can be primary. The primary growths are essentially of the connective-tissue type. Secondary carcinomatous growths may come from many sources, chief of which are the breast, the thyroid, the prostate, the uterus, the kidney, the alimentary tract. To these may be added the liver as in a remarkable case described by Catsaras. H. G. Wells describes a case with secondary growths in bone, the primary growth being in the urinary bladder. With this multiple source of primary growths available the diagnosis is very often a matter of exclusion of primary foci, one by one, or of finding confirmatory evidence in one primary site. This evidence may have been missed or undervalued. In a suspected hypernephromatous metastasis, what are the renal signs and symptoms to be investigated?

The cardinal symptoms of hypernephroma of the kidney are hæmaturia, pain, tumor. The hæmorrhage is said to have a twofold source, first, from veins in the kidney substance congested by mechanical pressure of the new-growth; second, from the vascular tumor substance which has erupted into the pelvis of the kidney. The hæmaturia may be slight or profuse, it may be constant or intermittent. It is sometimes provoked by exercise or trauma. Hæmaturia is said to be "the first indication of the disease in more than half the cases." (Lilienthal.)

Pain is usually vague, indefinite and is referred to the lumbar region. It is said to be the initial symptom in about 30 per cent of cases. Renal colic is rare. When nerves are involved by tumor tissue, the pain may radiate in the distribution of these nerves, especially the ilio-inguinal and genitocrural. (Trotter.)

Tumor is found in many cases. In many others it is absent even at a late stage of the lesion.

Rise of temperature is another striking feature of a case which is in active progress. Israel reports it as present in 57 per cent of his cases. The temperature may rise to 102 or even 103°, and may be for some time the only manifestation. The existence of a high temperature otherwise unexplained should always lead to a search for hypernephroma. The cause of the fever is quite unknown.

Cachexia as a late phenomenon is at times very striking. This was pronounced in the case described by Burton Chance; one of Scudder's cases lost 30 pounds in 3 weeks, and in the case of C. S. the rapid emaciation was very noticeable.

It is possible for hypernephroma to exist along with other kidney lesions, e.g., tuberculosis (Albrecht) or calculus (Nogueira).

In regard to the treatment of hypernephroma, three sets of conditions have to be considered: (a) with no obvious metastasis, (b) with a solitary metastasis, and (c) with multiple metastases.

There can be little question regarding the first. Provided the other kidney be functioning, extirpation of the involved organ should be performed.

Where a solitary bone metastasis is present it is apparently worth while to remove the primary lesion in the kidney at the same time, if it be feasible to excise the metastasis. Two cases are recorded by Albrecht where the single bone metastasis was the only sign of general involvement manifested at autopsy. Another case is referred to by him where nephrectomy had been performed 12½ years previously; 3 years later a single metastasis in the scapula had been removed. At the date of writing, i.e., 9 years after the second operation, the patient was alive (quoted by Trotter).

Scudder, in recording a complete report on a case, first described by him in 1906, in which a shoulder-joint disarticulation was performed for a growth in the upper end of the humerus, mentions that when the patient died "a little less than 5 years after operation, wasting away as if with some blood disease," a complete postmortem examination was made of thorax, abdomen, and cranial cavity. No metastases were found in any part of the body. "The left kidney was as large as two adult fists. The man had had no symptoms so far as known from the kidney tumor. This case adds one more bit of evidence to the two cases from Hochenegg's Clinic, illustrating the fact that one bone metastasis may be the sole metastasis present in the body. Had a nephrectomy been done soon after the removal of the upper extremity containing the metastatic focus, the man's life would have been prolonged."

One difficulty that may present itself is that even with a metastatic bone deposit there may be no indication even on ureteral catheterization, or methylene blue injection, as to which kidney is involved (Pool). The fact that a primary tumor may not communicate with the pelvis of the kidney, or may be situated at one or other pole of the kidney, where it is incapable of producing symptoms by mechanical pressure, may lead to difficulty in deciding which side to explore. In such cases the method of perirenal inflation introduced by Carelli, and described by Hernaman-Johnson, may yield valuable information, at a smaller surgical cost, than a double renal exploration. It is claimed that the suprarenal gland can be

distinguished from the kidney by this manœuvre; if the procedure establishes itself, it is possible that it may be of considerable value in cases of hypernephroma.

In the presence of cachexia or of multiple metastases, operation would seem definitely contra-indicated. The only measures applicable are palliative. In any case as soon as there is reason to suspect hypernephroma a complete roentgenographic examination of the skeleton should be performed.

SUMMARY

1. Hypernephroma is a comparatively rare condition.

2. Bone is a "tissue of predilection" for this tumor.

3. The pathogeny of hypernephroma is still *sub judice*.

4. Metastasis to bone is chiefly via the blood stream.

5. The bony metastasis is sometimes the only metastatic focus.

6. Complete skeletal roentgenographic examination should be made in every suspected case.

7. While mainly a lesion of later middle life it is found in the young.

8. The malignancy of the condition varies enormously.

9. A solitary bone metastasis may be extirpated with good ultimate result.

10. In the presence of cachexia or multiple bone metastases, palliative measures only are advisable.

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INTRA-ABDOMINAL ADHESIONS[1]

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THE subject of adhesions is gaining in importance especially since the diagnosis has been enhanced by the aid of the roentgenogram; but the cure of the condition still remains one of the less encouraging aspects of our surgical work.

As it is generally considered, the subject may be said to fall into two large groups: congenital and acquired. A somewhat extensive literature has developed around the question of congenital adhesions, particularly since Jackson, Lane, Harris, and others have described the congenital anomalies in the forms of membranes, bands, kinks, which bear their names. The anomalies are sometimes regarded as the result either of failure of the gut to rotate and descend, or when rotation has taken place normally, as due to some anomalous development of the peritoneum and the mesentery. Not a few surgeons, myself included, steadfastly refuse to accept this non-inflammatory theory of such adhesions, bands, membranes, or whatever they may be termed. It is much more plausible to place the entire group in the other large division of our subject, that is, acquired adhesions.

These acquired adhesions fall into two natural divisions: inflammatory, including pelvic adhesions often due to collections of blood in the pelvic cavity; and peritoneal (operative). Those who oppose the theory of fetal mal-development as the cause of membranes, bands, etc., are almost unanimous in pointing out the striking fact that they are usually located at or near the part of the gut most prone to inflammation. It is no contradiction to admit the presence of the condition in the fetus or at birth, for there is enough evidence to show the possibility of pre-natal inflammation of the peritoneum to account for their presence, so that while they may be congenital they are not developmental anomalies, in the strict sense of the term.

Inflammatory adhesions may be constructive as well as destructive. It is a well-known fact that the serous covering of the inner wall of the abdominal cavity is unique in that it is capable of developing agglutinations and adhesions, which in some instances are benign and protective, such as occur in the familiar walling-off process which takes place in infectious conditions and which prevents the development of a diffused peritonitis. It is when nature fails to protect the abdominal cavity in this way that she invites death, unless early surgery can be resorted to with success. These adhesions are generally temporary, inasmuch as they usually become absorbed after the infectious process has subsided. The surgeon often imitates this method of nature of forming protective or constructive adhesions, which frequently are only coils of intestines lightly stuck together, when he introduces sheets of rubber, cigarette drains, and the like into the wound, the object being to have the infected portion of the peritoneal cavity shut off from the general peritoneal cavity.

Constructive adhesions are also seen in cases of spontaneous recovery from gunshot wounds of the abdomen, as well as in wound healing in the various anastomotic operations, when union of the opposed peritoneal surfaces of the two viscera takes place.

The responsible factor for the development of acquired adhesions is, in a word, the peritoneum under distress. That is to say, they are the result of peritoneal warfare against pathological bacteria. The peritoneum is a large complex membrane lined over its entire surface with a layer of endothelium the continuity of which is interrupted only at the fimbriated orifices of the fallopian tubes; its two functions being absorption and exudation. So long as the endothelial cells remain intact, the peritoneum can deal with and control infection, but when they are destroyed and displaced by a mechanical, chemical, or bacterial agent, a direct route is at once opened for the entrance of infection into the blood stream through the subendothelial vessels; the surrounding connective tissue then becomes the source of adhesions. In the very

[1] Read at the twenty-fifth anniversary meeting of the Jersey City Practitioners' Club, Jersey City, New Jersey, May 8, 1923.

early stages of the inflammatory process of a peritonitis, there is a serous effusion containing phagocytic cells. These cells rapidly ingest bacteria, which they carry to the subendothelial lymph spaces on the surface of the diaphragm. This protective serous effusion with its contained phagocytes destroys the infecting bacteria and carries other infectious agents away from the peritoneal cavity. In addition to this serous effusion there is formed a fine layer of fibrin which covers the visceral layer of the peritoneum. We must not lose sight of the fact that, in severe infections, the phagocytes may all be destroyed and the effusion thus lose its protective properties and become septic. The agglutinations of the coils of bowel, or constructive adhesions, referred to above, are due to their being covered by this fine layer of fibrin. At operation this is frequently seen in the form of plaques or masses, which formerly the surgeon wiped away, but which today he leaves undisturbed since he is aware of the defensive power of the peritoneum. This fibrinous layer serves to protect the endothelium from the action of toxins and enables the intestinal surfaces to adhere, thus mechanically limiting the spread of infection; it also provides fine strands or ladders along which the phagocytes may travel on their way to the scene of action of the peritoneal battle.

It is an easy transition from a consideration of constructive to the consideration of destructive adhesions of the peritoneal cavity. We are all aware that the most frequent site of troublesome adhesions is the upper right abdominal quadrant. The viscera most frequently involved are the gall bladder, the duodenum, and the transverse colon. The etiology of these particular adhesions is not far to seek, but whether or not they can be prevented is not so easy to say, except perhaps if every case of cholecystitis or other upper abdominal disorder were to be subjected to operation at the first sign of trouble, which even I would consider neither feasible nor even logical. With the involvement of the intestinal tract in the inflammatory process there arises the greater danger of intestinal obstruction with all its inherent seriousness. Unfortunately, many of these cases present symptoms of stasis and partial obstruction rather than those of actual inflammatory disease of the intestine, so that the surgery which might have relieved the inflammation and possibly prevented the development of adhesions is postponed. On the other hand, oftentimes visceroptosis is responsible for symptoms of adhesions. This, of course, is not a surgical condition, but for which operation is often erroneously undertaken with the idea of relieving some supposed upper abdominal lesion. With the X-ray diagnosis of visceroptosis this mistake should not occur, but where this means of diagnosis has been omitted or is not available, the mistake is a very natural one, for it is sometimes absolutely impossible to differentiate visceroptosis and upper abdominal disease.

While surgery designed to relieve inflammation may also at the same time prevent the formation of inflammatory, destructive adhesions, we must humbly confess that surgery also is responsible for the development of troublesome adhesions. The various methods devised for the prevention of such operative sequelæ form an interesting chapter in surgical endeavor.

Among the many factors held responsible for the formation of postoperative adhesions may be mentioned free blood in the peritoneal cavity, sutures and ligatures, the effects of the eschar of the cautery, exposure of the viscera to air, chemical irritation and infection. Regarding the presence of free blood alone as a cause, it can be said to be only a concomitant one in the presence of infection or trauma. Ligatures and sutures likewise cannot be held responsible, if properly and wisely applied and if the stumps of pedicles are carefully treated. The cautery, if thoroughly applied, without doubt prevents the formation of adhesions, but mild and insufficient heat may cause their development. Exposing the peritoneum and the viscera to the air not only produces shock but favors the formation of adhesions, but it seems superfluous at this juncture to urge careful technique in this respect, since it should be entirely a matter of course. Before the introduction of asepsis chemical irritation was an active factor, and today also experimental work with

iodine, iodoform, carbolic acid, etc., conclusively proves the rôle of chemical irritants as possible contributing factors to the phenomenon. The part played by infection in the development of both pre-operative and postoperative adhesions is obvious. It is trauma in the widest application of the term, and trauma is without doubt an important item in the formation of destructive adhesions.

The deduction is plain that first among the prophylactic measures stands careful operative technique; strict asepsis; avoiding trauma, mechanical and chemical; careful treatment of denuded surfaces; a minimum of handling of viscera, avoiding exposure of the peritoneum and viscera to air, the use of hot moist gauze pads for the protection of the abdominal cavity.

Literature abounds with suggestions for the use of various foreign materials for the prevention of postoperative adhesions. Various operators have advocated the use of non-absorbable membranes, intended to protect the surfaces until regeneration of the endothelium has taken place. But the results have not justified their claims to usefulness.

Various lubricants also are more or less widely employed in abdominal operations for the prevention of adhesions. But I doubt whether the results are any more encouraging than those obtained with the use of membranes.

Non-viable membranes, particularly Cargile membranes have been advocated in various quarters, but they have not survived their early enthusiastic supporters. Much more rational is the introduction of viable grafts of peritoneum and omentum. Senn, as early as 1888, showed by experiment that omental grafts from 3 to 6 centimeters in width and of sufficient length to surround the bowel, retain their viability and become adherent in from 12 to 18 hours, and are well supplied with blood vessels in from 18 to 48 hours. He also showed that scarifying the serous surface and the grafts promotes agglutination and vascularization. He recommended the method for operations on the intestinal tract, for re-inforcing enterorrhaphy and for covering stumps and peritoneal defects. This method with modifications has come to occupy an important place and widespread application in modern abdominal surgery, and to this day represents probably the most valuable means at our disposal for controlling the formation of adhesions.

Pre-operative and postoperative treatment also plays a certain part in the prevention of adhesions. Inciting peristalsis with the idea of liberating early adhesions and by constant motility of the bowel preventing their recurrence, formerly received and today also is receiving considerable attention, but it is neither logical nor effective, except perhaps in the few selected cases in which it has been reported as being successfully applied. Personally I am opposed to pre-operative and more particularly to postoperative purgation. All aperients act as irritating poisons on the intestinal mucosa. The resulting irritation renders the intestinal wall more easily penetrable by bacteria, and, furthermore, the active peristaltic contractions disturb the protective layer of fibrin with which the peritoneal layer of the intestines is covered, and thus create the chance for adhesions to develop. I do find, however, that having the patient get out of bed as soon as is consistent with conditions and with the pathology treated is a wise prophylactic measure. After discharge from the hospital, suitable exercises, such as gymnastics, swimming, etc., are useful for breaking up slight adhesions and perhaps preventing the formation of others.

The most serious immediate postoperative danger is, without doubt, intestinal obstruction, occurring from 3 to 10 days or more after operation. This sequel, of course, most commonly takes place after acute abdominal conditions, particularly acute suppurative and perforative appendicitis. The obstruction is practically always caused by adhesions which, at first constructive, later become destructive. But intestinal obstruction may also occur after operation on a clean abdomen, but the cases are so few and far between that the subject needs merely to be mentioned. Reoperation in these cases of acute postoperative intestinal obstruction is usually very successful and the end-results eminently satisfactory.

Less satisfactory and more perplexing are the cases of adhesions which lead to chronic intestinal stasis with its associated toxæmia and disability. Very often, as I have already indicated, this chronic condition is mistaken for visceroptosis and vice versa, and very often either or both are associated with neurosis. The trio, chronic intestinal stasis, visceroptosis, and neurosis, to my mind, is nothing less than diabolical. Surgery may be, but very rarely is, successful in these cases. I personally refer this type for medical treatment, recommending proper posture, fresh air, forced feeding, massage, hydrotherapy, and the like. There is little doubt that these cases are the source of profitable income to the various "pathies," chiro-, osteo-, and the like. To the surgeon they are troublesome because they are so often referred to him with a diagnosis of chronic appendicitis or chronic cholecystitis. In fact, it is remarkable how exactly they do mimic upper abdominal disease. In some instances removing the appendix, and perhaps the gall bladder, may be called for and may relieve the condition. But frankly, I do not like to operate on these cases, and more often refuse to use the knife than I apply it. They are the bugbear of the surgeon and the internist alike, and require time and patience for their relief.

You all no doubt have had the experience of having to operate two or three times on the same patient for the release of adhesions, and no doubt you also have observed the fact that there are fewer adhesions at the second and third operation than were present at the first. While this fact may be a hint on nature's part that in time many of the cases may clear up spontaneously, it is more plausible to regard it with satisfaction as one of the many instances in which surgery comes to the aid of nature in relieving a distressing condition for which nature frequently demands too much time.

COLLATERAL CIRCULATION IN CHRONIC OBSTRUCTION OF THE PULMONARY VEINS AND ITS RELATION TO AIR EMBOLISM FOLLOWING VARIOUS DIAGNOSTIC AND THERAPEUTIC PROCEDURES (PNEUMOLYSIS)

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FEW data are given in the literature relative to the formation of collaterals following chronic obstruction (partial occlusion) of the pulmonary veins due to compression of the lumen from the outside by chronic inflammatory changes. During the winter of 1921–1922 I performed a series of experiments on dogs to study the anatomical changes following the partial occlusion of the pulmonary veins. A condition was created experimentally in one lung analogous to that found in clinical cases of chronic inflammation in the region of the hilus—generally of tuberculous origin—obstructing the backflow of the blood in the pulmonary veins to the left auricle. This condition can be compared to the stasis in the pulmonary veins in cases of a non-compensated heart lesion of the left side. The study of the pathologic-anatomical changes in the lung and the pleura in these experiments enables us to throw some light on the etiology of collateral formation observed in cases of chronic lung tuberculosis (Guyot, 1). It gives also an accurate explanation for the few cases of air embolism which occurred through these collaterals into the greater circulation and the right heart.

RÉSUMÉ OF EXPERIMENTAL WORK

A. Technique. The operation was performed on the left lung of medium sized dogs, using intratracheal insufflation anæsthesia. The animal was placed on his right side. By an intercostal incision (fifth interspace) the pleural cavity was opened and the hilus well exposed by retracting the lung of the dog backward. As a rule, there were three big veins entering the left auricle, taking up the blood of the upper, middle, lower lobes. Sometimes the pulmonary vein of the upper lobe was divided into a smaller upper and a lower one. With a ligature of heavy white silk (in one case with a silver wire) the lumen of each vein was reduced to one-third or one-quarter of its normal caliber, a probe being passed underneath the ligature during the tie. After perfect hæmostasis in the chest wound the cavity was closed with interrupted pericostal silk stitches, the lung being blown up at the same time to its normal volume. Suturing of the muscles in two rows, and of the subcutaneous tissue and the skin with silk made the closure very tight. The dogs stood this operation very well. No changes in the rate of the heartbeat or in the respiration were noted. When recovering from the anæsthesia the animals were less active for 1 or 2 days; respiration was deeper but more rapid, perhaps partly due to pain in the chest wound. These postoperative sequelæ showed great variability in the different dogs; 30 hours afterward some were quite as active as before the operation. Generally after 48 hours, sometimes earlier, the dogs were normally active. The variation of these sequelæ in the different dogs may be governed more by subjective feelings than by any physiological bases. Deeper breathing increases the gaseous exchange.

B. Findings. Following operation the size of the two lungs remains about the same for a short time (5 to 7 days). An engorgement of all the blood vessels of the obstructed side takes place as a result of the stasis. The blood flow through this lung is reduced. The physiological function becomes reduced also. On the non-obstructed side an increased blood flow is guaranteed by an elevation of the blood pressure in the lung artery (Underhill, 2), but especially by the dilatation of the capillaries outlining the air sacs. This causes an enlargement of the alveolar wall; the alveoli expand (v. Basch 3), the aeration surface becomes greater. A compensatory hypertrophy (expansion) takes place, and an enlargement of

the lung results. So we see the non-obstructed lung pushing the mediastinum to the obstructed side, particularly at certain anatomically weak points—in the dog, for instance, in the anterior upper mediastinum (Fig. 1). A second displacement (lower groove in the diagram) occurs anteriorly below the heart. A constant result due to the same mechanism is the interposition of the mediastinal lobe, a median lobule of the right lower lobe, between the left lower lobe and the diaphragm.

The formation of adhesions on the obstructed side was a very inconstant finding in the specimens. If present, these adhesions were restricted to the regions where the very friable endothelium (Boit, 4) was injured mechanically at the time of operation, either by retracting the lung in exposing the hilus region; or along the line of incision on the anterior chest wall, or in the neighborhood of the place of the partial occlusion of the pulmonary veins. In this way a synechia of the two pleural layers occurred along the mediastinal side and along the incision in the chest wall. This obliteration was, pathologically, a circumscribed fibrinous pleurisy. During the process of organization of this inflammation, capillaries were growing in from the lung side, from the mediastinum and the chest wall. These blood vessels form the basis for abnormal collaterals in two specimens described in detail below.

In a medium sized dog on which the operation was performed as outlined above, and which was sacrificed 3 months (85 days) later, the displacement of the mediastinum corresponded to the description given above and illustrated in Figures 1 and 2. The upper lobe of the right lung pushed the thin mediastinum over to the left, compressing the left lung quite considerably—the result of the compensatory enlargement of the right lung. An upper groove is formed in this way. By an analogous process, the middle lobe forms a lower groove below and anterior to the heart. In Figure 2, where the upper and middle lobes of the right lung were retracted laterally and a window cut into the lower mediastinal sheet of the right pleura, the mediastinal lobe is shown interposed between the left diaphragm and the lower left lung lobe, and lifting up the heart to a certain extent. This mediastinal lobe extends well over to the left lateral costal margin, passing behind the inferior vena cava. The pleural cavity adjacent to the mediastinum is obliterated to a great extent. The two pleural surfaces are firmly adherent. Arising from the upper and the lower lobe in separate groups a number of tortuous, enlarged veins are seen running between the adherent pleural layers and joining the left internal mammary vein posterior to the chest wall. The costal and diaphragmatic pleural surfaces are intact; no adhesions are present. Figure 3 shows the partial obliteration of the pleural cavity, between the mediastinum and the upper lung lobe. At the place where the two sheaths are glued together these new blood vessels issue from the lung and can be followed along the mediastinal pleura. The pericardium is fixed to the lung. Enlarged blood vessels underneath this thin sheath join the pericardiaco-phrenic vein. A third group of veins originates in the hilus region and from the mediastinal aspect of the lower lobe. These veins form the second group of new blood vessels running within the mediastinal pleura toward the chest wall, where they join the internal mammary vein.

The photographs, taken immediately after death, do not show the true proportion in size of the two lungs; the right one being considerably smaller as a result of its postmortem contraction, a sequence of its elasticity; the left lung keeping its size as during life, an effect of the chronic stasis and the increased fibrous consistency. The fact that the two postmortem lungs are about the same size proves that the reduction in size of the obstructed side is a moderate one. This is also illustrated by comparing the two lungs autopsied in the same way after the same lapse of time in cases where the pulmonary artery was ligated with or without resection of the phrenic nerve. The very marked stasis in the obstructed lung circulation is an impediment to further reduction of lung volume at this early stage.

On a second dog the same operation was performed on the left lung. The partial occlusion of the pulmonary veins was combined with crushing of the phrenic nerve for a distance of 2 centimeters. The animal made an uneventful recovery. He felt well and showed no signs

of respiratory distress. He was sacrificed after 4 months (130 days). When the anterior chest wall was removed, the same picture was found, showing the difference in the size of the two lungs, as depicted in Figures 1 and 2. No veins coming from the lung running to the internal mammary vein were seen. The two internal mammary veins were very small vessels running along with the corresponding artery. The left lung was adherent along the mediastinum; the few small adhesions along the scar of operation were easily separated. The remaining part of the costal and diaphragmatic pleura was free. By pushing the left lung to the right, the following very interesting findings were recorded (Fig. 4): A group of engorged, dark bluish blood vessels on the mediastinal aspect of the upper lobe is taken up by few large veins running with the phrenic nerve and emptying into the first intercostal vein. These veins are in communication with branches of a second group of vessels which have their origin in the region of the hilus as enlarged bronchial veins which run to the left of the œsophagus into the azygos vein together with the fourth left intercostal vein. Note in our first dog described above this venous tract was very insignificant. Along the anterior aspect of the œsophagus these bronchial veins are in communication with enlarged œsophageal veins which join the azygos vein together with veins from the diaphragm.

C. Discussion. These findings were present in two dogs out of a series of seven analogous experiments. Except in one dog sacrificed 2 days after the operation, whose pleural cavity was free, the same form of adhesions were found restricted to the mediastinal pleura, and in four cases to the scar. The size of the involved area varied considerably.

In the two cases referred to two different methods of overcoming the stasis in the lung are demonstrated: (1) by using new blood vessels crossing these adhesions between the two pleural sheaths and communicating, as in our first case, with the internal mammary vein. In this observation the pericardiacophrenic vein was also active as an outlet for the accumulated arterialized blood in the pulmonary veins. The latter was also encountered in our second observation; but in our second case the normal way through the bronchial veins became more patulous, enlarged, and tortuous, thus forming the second method of repair. The dilatation in the bronchial veins had taken place as far back as the smaller branches emerging from the lung surface. Also some of the branches communicating with the pericardiaco-phrenic veins and along the œsophagus with the œsophageal veins were dilated, and with their dark blue color, gave to the specimen a striking appearance.

As pointed out by Boit (4), the endothelial covering of the pleura is very easily injured; even when exposed to dry air for one-half to one hour, Boit found the lung surface of dogs dull and wrinkled. Later this endothelium became necrotic. This is the explanation of similar changes in our experiments, due to the exposure and to the handling at the time of the operation. This explains also the constancy of the circumscribed areas of adhesion formation along the mediastinal side of the lung and toward the line of incision in the chest wall. The number of adhesions is governed besides by a certain constitutional factor, because with the same traumatism on the pleura or peritoneum the reactionary adhesion formation varies in different animals and also human beings. The vulnerability of the pleura may differ in degree in different individuals. The reactionary fibrinous deposit at the point of injury, which glues the two surfaces together, is different also. New blood vessels grow into this fibrinous layer from the lung as branches of the pulmonary arterial system. From the opposite side also buds of blood vessels grow into the fibrin, which is gradually replaced by fibrous tissue. In the presence of a chronic stasis in the lung, as was obtained in these experiments by partial occlusion of the pulmonary veins, and in many cases of chronic inflammation in the deeper layers of a lung (tuberculosis) some of these blood vessels become enlarged. They form the basis for the collaterals between the pulmonary and the systemic circulation. On the cadaver Guyot (1) was able to prove the existence of such collaterals in many instances, although in only a few instances do they become so large as to cause the formation of an eventual air

embolus during a diagnostic or therapeutic procedure, such as a puncture or a pneumolysis. This will be considered more in detail in the clinical part.

The formation of new collaterals is one way in which nature tries to overcome a chronic stasis in the lung. Our second observation illustrates the other way, i.e., the use of existing efferent venous vessels of the lung, the bronchial veins, and their communication with the pericardiaco-phrenic vein into the veins of the upper thoracic aperture, and along the œsophagus with branches of the œsophageal veins. Certain minor anomalies within the lung in some cases favor the formation of collaterals by enlarging the bed of existing blood vessels. Usually these anomalies involve only the capillaries.

Affecting the larger branches of the pulmonary veins as a result of the persistence of certain embryological stages in adults, MacCready (5) was able to demonstrate large communications of the pulmonary veins with the subclavian, innominate, superior and inferior vena cava, and the azygos in several rare observations recorded in the literature or met with in 3 cases in the dissecting room of the anatomical department of the Johns Hopkins Medical School. In 2 cases the upper pulmonary vein of the left side opened into the left innominate vein; in the third case the upper pulmonary vein of the right side emptied into the superior vena cava, owing to the persistently patent communication of the splanchnic plexus surrounding the primitive intestinal tract, later also the lung buds, and the veins of the systemic and portal circulation.

In 1911, Tiegel (6) made a one-sided partial occlusion of the pulmonary veins in dogs. At autopsy several months afterward he found collaterals running through adhesions between the mediastinum, the pericardium, and the thoracic wall. In one specimen the new blood vessels on the mediastinal side of the lung were particularly striking. Tiegel explains the decrease of the primary stasis in the obstructed lung by this new outlet through these collaterals without paying special attention to the clinical importance of this pathologic-anatomical finding.

CLINICAL STUDY

a. Findings. Analogous changes in lungs with a chronic inflammatory condition in the region of the hilus which causes an obstruction to the backflow of the blood in the pulmonary veins are not so rare in man; but their frequency can only be determined by a thorough examination at autopsy in a large series of cases, as it was done by Guyot in a restricted number. We shall show in a subsequent chapter the different routes followed by these collaterals from the pulmonary into the greater circulation. The size of these new vessels and the frequency of their formation is of great clinical importance as a complicating factor following different diagnostic or therapeutic procedures in chest conditions. A study of collaterals passing from the upper lobe through adhesions to the chest wall and mediastinum would be particularly instructive, since it is in this locality that we most frequently meet with adhesions, the upper lobe being beside the common primary seat of a tuberculous process. These collaterals, by joining the internal mammary vein (as we found in our first case) set up a direct communication with the large veins in the neck, where the pressure is negative, thus giving rise to the possibility of an air embolism.

Experimenting on cadavers with long standing pleural adhesions, Guyot (1) injected the stem or one branch of the pulmonary artery with Prussian blue solution (glycerine-water suspension). In 11 out of 16 cases the blue passed through these adhesions; in 10 of these 11 cases an obstacle was present, the cause of which was a parenchymatous infiltration (tuberculosis, 7; pneumonia, 2). In one case the lung was atelectatic. Guyot produced adhesions in the lungs of dogs by injecting iodine and turpentine into the pleural cavity. The adhesions resulting from this artificial pleurisy were not patent for the Prussian blue injected in the usual manner into the pulmonary artery. Guyot concluded that this negative finding was due to a lack of obstruction to the blood flow of these lungs. The blood vessels passing through the adhesions were too small to become permeable for the dye.

In one case of caseous lung tuberculosis with cavitation the blue flowed through the

adhesions on the chest wall into an intercostal vein. In another case, also lung tuberculosis, an anastomosis with a diaphragmatic vein was found.

As observed in our experiments and verified clinically by Guyot's injections on cadavers, the pleural adhesions following fibrinous pleurisy in lung disease with a chronic obstruction of the pulmonary veins form the basis for collaterals between the pulmonary and systemic circulation. This takes place usually in deeper-seated inflammatory zones, as in chronic tuberculosis, particularly following a process of secondary contraction. The blood vessels which organize the fibrin deposit on the lung surface by communication with each other in the presence of this stasis, become the natural outlet for the blocked arterialized blood in the superficial parts of the diseased lung. As the pneumonic process becomes diffuse centrifugally from its primary focus, the stasis becomes more pronounced. These new collaterals leading into the greater circulation and the right heart develop more and more, counteracting the ill effects of the stasis in the lung. The more these collaterals enlarge, the greater becomes the danger of an air embolism, as will be described later. Forlanini assumed that in lung tuberculosis this vascular anastomosis quite frequently counteracts the increasing stasis in the pulmonary veins. Guyot's experiments, applied to a larger series of cases, would bring out very interesting findings and enlarge our knowledge of this abnormal repair process which takes place through the pleural adhesions. This would give us also a sound basis for calculating the frequency of the danger of air embolism when carrying out a diagnostic or therapeutic procedure on tuberculous patients.

b. Complications. Before taking up the report of cases of air-embolism through the greater circulation following different procedures on the lung, we have to consider briefly the pathologic-anatomical changes which confront us in these observations. The new collaterals, the result of persisting blood vessels grown in during the organization of a fibrinous pleurisy, become, as time passes, surrounded by fibrous tissue. In the presence of an infection this connective tissue becomes denser and denser. A constitutional factor may also be active in these cases. As we are dealing with a chronic condition, time is a great and essential factor. The blood vessels within the fibrous tissue are suspended: i.e., fixed and dilated. The tendency of this tissue to a secondary contraction favors particularly the dilatation of these veins, the walls being less resistant than the more muscular artery walls. When such a vein is injured mechanically, either by a puncture needle (puncture: pneumothorax), or by a blunt instrument (finger: pneumolysis), the veins cannot contract to their full extent, being hampered by their attachment to this inelastic tissue. The musculature of the vein, being weaker than that of the artery, becomes insufficient. The rent in the vessel wall remains open. A laceration of the new collaterals arising from the upper lobe and running to the innominate vein by way of the internal mammary vein brings about the same condition as that occurring in a goiter operation or a dissection of any other structure in the neck when a larger vein is torn; an air embolism into the right heart occurs. As we shall see later, not every air embolus becomes clinically manifest, especially in instances where the blood flow is slow, so that in the presence of air within the vessel too great inertia predisposes to clot formation.

A case of air embolus, probably into the greater circulation, following a thoracic *puncture* was published by Zink (7).

A woman, 40 years old, had tuberculosis of the right lung of 2 years' duration, the upper lobe especially being involved. Using the puncture (Forlanini-Saugmann) method, a partial pneumothorax with nitrogen gas was obtained. The first filling was performed without any complications; 400 cubic centimeters of nitrogen were injected. During the next treatment, while the cavity was being refilled, patient complained of oppression following the injection of 100 cubic centimeters of nitrogen. The filling was continued. After 300 cubic centimeters of nitrogen had been introduced, the pressure in the pneumothorax cavity was +12 water. The needle was withdrawn. For a while the doctor kept talking with the patient; then he started a physical examination of the chest, when the woman suddenly collapsed. She became unconscious, the pupils were extremely wide, the pulse could not be felt. A striking feature was a circumscribed patchy discoloration of the skin over the right forearm and around the puncture wound. There was marked cyanosis of the face. Following

rhythmic traction of the tongue the patient began to breathe again. She improved very slowly under the stimulation of analeptics; corneal and pupillary reflexes could be obtained again, but the patient remained unconscious for the rest of the day. She had a few attacks of general convulsion of short duration. No palsy could be made out. The next day the coma became deeper. A tonic contraction of the right arm appeared and became more and more pronounced. Cheyne-Stokes breathing became conspicuous, and the patient died 24 hours after the onset of the accident.

Autopsy. A great number of air bubbles were found in the pia veins; but as these veins were lacerated when opening up the skull the origin of these air bubbles remains uncertain. The right lung was fixed to the chest wall by firm adhesions. On the thoracic side of the pneumothorax cavity no signs of mechanical injury could be made out. At one place, where the adhesions were loosened up, a bloody effusion of the tissue was noted. No openings were found in any of the larger blood vessels. On section the right lung was full of caseous pneumonic areas. Two cavities, each one the size of a cherry, were seen. When taking out the heart no special attention was paid to the eventual presence of gas (nitrogen). Unfortunately the pathological findings of the autopsy are so incomplete that they do not explain clearly the clinical picture.

Zink assumes that the embolus originated in a vein of the thoracic wall. It is probable that an enlarged vein passing through the adhesions at the border of the pneumothorax cavity was torn off by the pressure in the cavity. The pathological findings in this lung account for the obstruction to the blood in the pulmonary veins in the superficial part of the lobe. This case illustrates very well the danger of breaking up adhesions over one lung in the endeavor to transform a partial pneumothorax into a total one by increasing the gas pressure. Jacobaeus (8) tried to diminish this danger by using the cautery (thoracoscope) to burn off the strands of adhesions along the costal wall, forming in this way an escharotic plug in the vessels crossing the adhesions.

We have to consider the presence of these new collateral veins along the mediastinal side of the upper lobe particularly when performing a *pneumolysis* in this area, i.e., when mobilizing the upper lung lobe by blunt dissection out of its attachment to the thoracic wall, to interpose a mass (fat, muscle, or paraffin) in the cavity thus formed, forcing the lung to a collapse by pressure from the outside.

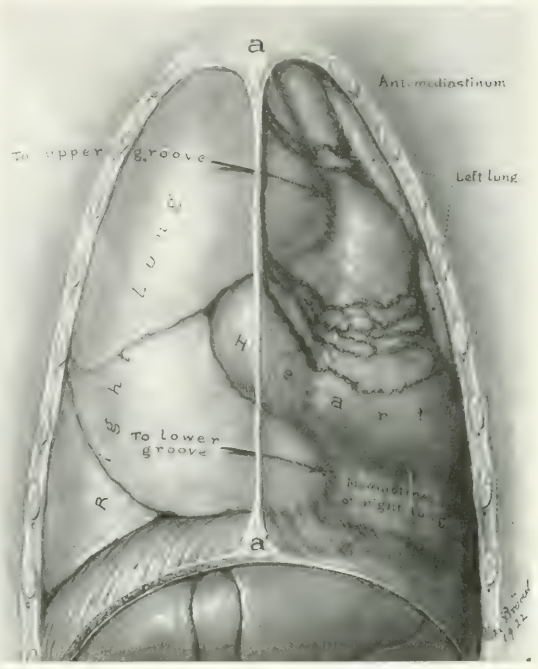

Fig. 1. Site of the organs of the chest in a dog, 85 days after partial occlusion of the pulmonary veins of the left lung. Note the displacement of the anterior mediastinum, of the heart toward side operated upon, and of mediastinal lobe owing to the enlargement of the right lung. Collaterals from the left lung through pleural adhesions running within the mediastinum to the left internal mammary vein. (The unilateral atrophy of the left side of the diaphragm resulting from resection of the phrenic nerve was taken from another specimen.)

In Delorme's (9) *decortication* for old empyema cavities, or in Ransohoff's (10) discission of the pulmonary pleura, the danger of this form of embolism into the greater circulation is present when the lung is liberated from adhesions to the chest wall. In the decortication or discission itself where the constricting, scarry coat over the lung is taken off or incised the usual origin of air embolism is through the lung veins (stretched in fibrous tissue) into the left auricle and into the systemic circulation (eye, brain). In the presence of pleural adhesions we have to think of abnormal collaterals through these adhesions to the upper thoracic veins as cause of an air embolus. In cases with death the autopsy will clear up the etiology of the fatal embolus. These two different sources have to be considered in the presence of an embolism following pneumotomy for the drainage of a lung abscess. When performing

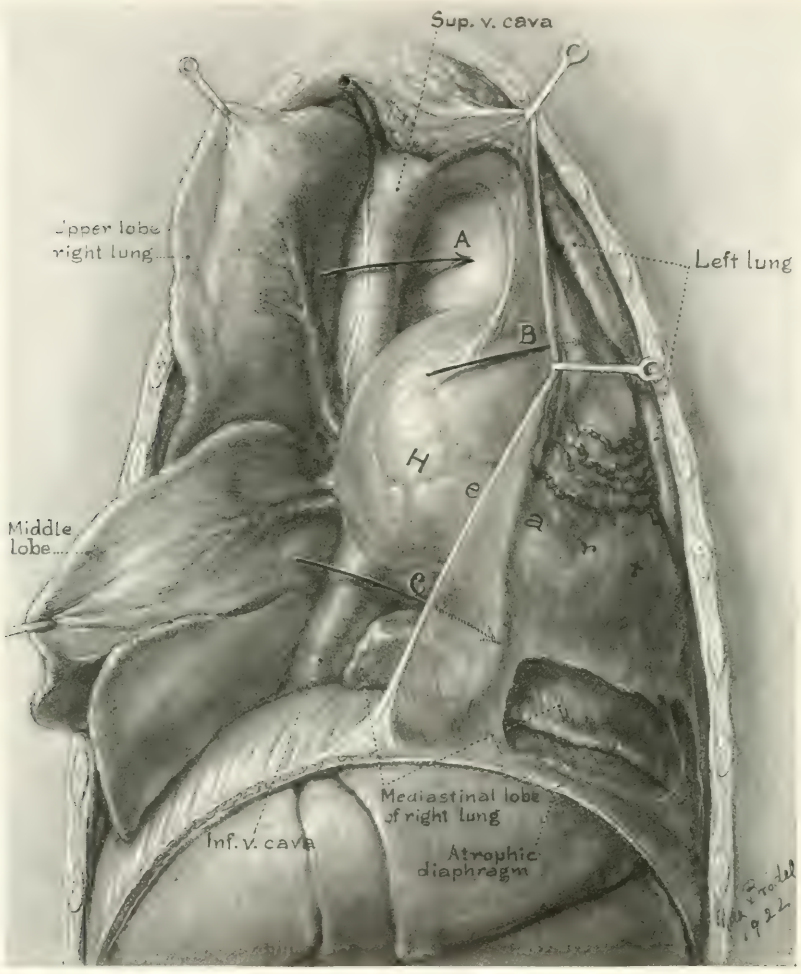

Fig. 2. Site of the organs of the chest of the same dog, as in Figure 1. Note the hollowing out of the mediastinum by the distended right lung. Interposition of the right mediastinal lobe between the diaphragm and the left lung. Collaterals between the left lung and the left internal mammary vein. (Unilateral atrophy of the diaphragm on its left side following resection of the left phrenic nerve taken from another specimen.)

a pneumectomy of the upper lobe, these collaterals with the greater circulation have to be kept in mind. A case is reported by Beneke (11), who, in reviewing the literature and by a questionnaire among the competent colleagues of that time, was unable to get the record of an analogous observation. This unique case from the Garrè clinic, in which the etiology of the incident was discovered at autopsy, may be quoted as a further proof of the importance of this special clinico-pathological entity.

A man, 47 years old, had suffered for one year and a half with a severe cough with expectoration. He was admitted to the clinic with the diagnosis of abscess of the upper left lung lobe. Under general anæsthesia, the second to the fifth ribs were resected on the left side anteriorly. The pleural cavity was obliterated by dense fibrous adhesions. Partly by sharp, partly by blunt dissection, the upper lobe was liberated on its mediastinal side toward the hilus, when suddenly a profuse venous bleeding from the bottom of the wound occurred. The anæsthetist noticed that the condition of the patient was becoming critical; the pulse could no longer be felt, the patient became pale, and lost consciousness. The wound was packed with gauze. With different analeptics a temporary slight improvement seemed noticeable, but a short time afterward the patient died. The autopsy performed the following day

showed that the left upper lobe had been liberated from scar tissue in an area the size of the palm of the hand. Some lung tissue was left attached to the mediastinal side. The surface of the lung was irregular, and showed several torn blood vessels. A large lung vein was exposed along the lung surface with a rent 5 millimeters in diameter in its lumen. This vein was 2 centimeters from the hilus, and separated from it by a bronchiectatic sinuous cavity which was outlined by granulation tissue and communicated freely with the main bronchus by a canal admitting one finger. In all the branches of the pulmonary artery of the right lung a great number of air bubbles were found. The heart was pale, relaxed, and seemed to be empty. There were air bubbles in the coronary veins. No ecchymoses were noted. The *right* auricle and ventricle contained frothy blood, particularly between the trabeculæ. The foramen ovale was closed. The arteries of the neck were not examined for a possible air content. The middle meningeal arteries were filled with a great number of air bubbles. The corresponding veins also contained air. This was very conspicuous in the longitudinal and the cavernous sinus, but also in the transverse sinus. There was air in the vessels of the spleen, in the veins of the liver, the bladder, and of the lower extremities.

In the case of Zink (7) there was in all probability an air embolus through the greater circulation. A more accurate description of the autopsy findings would help to settle the question. In Beneke's case (11), the frothy blood in the right heart, and the great number of air bubbles in the right lung indicate air embolism in the greater circulation. The air bubbles which were scattered throughout the systemic circulation reached it by way of the lung. In this case we are justified in assuming that an analogous collateral communication with the internal mammary vein had been formed, as in our first experiment. In Beneke's case, profuse bleeding necessitated the immediate cessation of the operation. The lung vein protruding from the lung surface may have been the new collateral. By packing the wound further embolus was stopped. An abscess close to the hilus was the cause of the stasis in the lung lobe. With its fibrous envelope the abscess compressed the larger vessels, chiefly the veins with their less rigid wall. A chronic obstruction was the predisposing factor in the formation of these collaterals. The extensive lesion of the left lung diminished its function to a great extent. As will be shown in a subsequent paper, under these conditions the unaffected lung assumes the function of the diseased side. In a lung, for instance, brought to physiological rest by ligation of the pulmonary artery, the opposite side enlarges, as has been demonstrated after one-sided pneumectomy by Heuer and Andrus (12). An enlargement of the capillaries in the sound side causes an active enlargement of all the alveoli, in this way enlarging the respiratory surface. Through these enlarged capillaries, the blood has an increased flow. An accessory factor in these cases is the higher blood pressure in the pulmonary artery, as has been observed by Underhill (2). This also explains why in Beneke's case so much air could pass through the sound right lung into the systemic circulation, and even later on through the capillary bed into the venous side of different organs, such as the heart, brain, spleen, liver, bladder, and the extremities.

The air emboli through these new collaterals of the pulmonary veins and the veins of the upper thoracic aperture show clinically the same picture as the emboli arising during operations on the neck (goiter, gland-dissection), where a vein in communication with the superior vena cava aspirates air on account of its peculiar position in the tissues. An additional factor may be the position of the neck at the same time. When air enters the right heart, it causes the mill-murmur, metallic in character and often so loud at first that it can be heard at a distance of 1 to 2 meters. The murmur is the same as that of water striking the wheel of a water mill. The clinical manifestations of such an embolus are rather due to the symptoms caused by the air entering the systemic circulation and going to the vital centers of the brain after having passed through the lung. This is particularly apt to occur when the patient is kept in an erect position. Kleinschmidt (13), reasoning from experimental observations, came to the conclusion that death following these accidents is due to the accumulation of air in the right heart. A discrepancy exists between the clinical picture in man and the experimental findings in dogs. Forlanini (14) slowly injected air intravenously in dogs; no symptoms followed. Gundermann (15) made the same observation. In

Fig. 3. Photograph of the specimen of the same dog, as in Figures 1 and 2. *C*, Collaterals from the pulmonary veins through pleural adhesions and within the mediastinum toward the left internal mammary vein. *P*, enlarged pericardiaco-phrenic vein with phrenic nerve. Pericardium adherent to the lung. Right lung contracted (elasticity).

dogs in a flat position I injected 60 cubic centimeters of air into the jugular vein in three consecutive injections at intervals of 3 to 5 minutes without causing any alarming symptoms. In my experiments, as in those of Forlanini, a loud mill-murmur was audible which became less pronounced within 5 to 10 minutes, and diminished gradually until after 15 minutes it subsided. Forlanini injected into dogs 10 to 15 cubic centimeters of air per minute for half an hour without killing the animals. Very rapid intravenous injections of air cause sudden death by dilatation of the right heart (Kleinschmidt, 13). This might explain the clinical symptoms of respiratory distress and heart failure observed in man even after a small quantity. With the patient in the erect position, an embolus into the brain and the medulla is more likely to occur. When I injected only 20 cubic centimeters of air into the right heart through the jugular vein in a dog in the flat position, and then elevated the head of the animal, respiration suddenly ceased and the heart stopped beating.

The prognosis is more favorable when the air emboli pass through the right heart than when air passes through the left heart. By injecting only 0.5 cubic centimeter of air into the left heart of a dog Forlanini produced a sudden death. If the embolism through the right heart becomes clinically evident it is generally because the air passes through the lung into the left heart and into the systemic circulation; we then have all the symptoms which I have described in a previous paper on intrapleural reflexes (16). The erect position facilitates aspiration of air when a vein in communication with the vessels of the upper thoracic aperture is injured. This position predisposes to the passage of air from the right heart into the pulmonary vessels, into the left ventricle and into the brain, causing there serious sequelæ. With the patient in the Trendelenburg position the opening in the vein is at a lower level than the heart; this position also tends to combat the progression of the embolus and to diminish the danger of air passing through the lung into the left heart and into the cerebral circulation.

SUMMARY

Our experiments on dogs demonstrate the formation of collaterals between the pulmonary and systemic circulation consequent to the chronic stasis following partial occlusion of the pulmonary veins of one lung. This gives us an explanation for certain pathological processes governing the changes in chronic inflammatory conditions with obstruction of the pulmonary veins of one lung in man. Guyot's injection experiments on the cadaver prove that a chronic obstruction to the blood flow in the pulmonary vein with pleural adhesions is the main factor in initiating the formation of these collaterals, nature endeavoring thus to counteract an increasing stasis in the lung. The enlargement of the normal venous pathway from the lung into the azygos vein (bronchial veins) is an additional factor used by nature in overcoming the chronic obstruction in the superficial pulmonary veins. The formation of new collaterals to the veins of the upper thoracic aperture is of greatest clinical importance. Having the pathologic-anatomical picture of this condition in mind, special attention is indicated in any cases of chronic lung tuberculosis when performing a puncture for diagnostic or therapeutic (pneu-

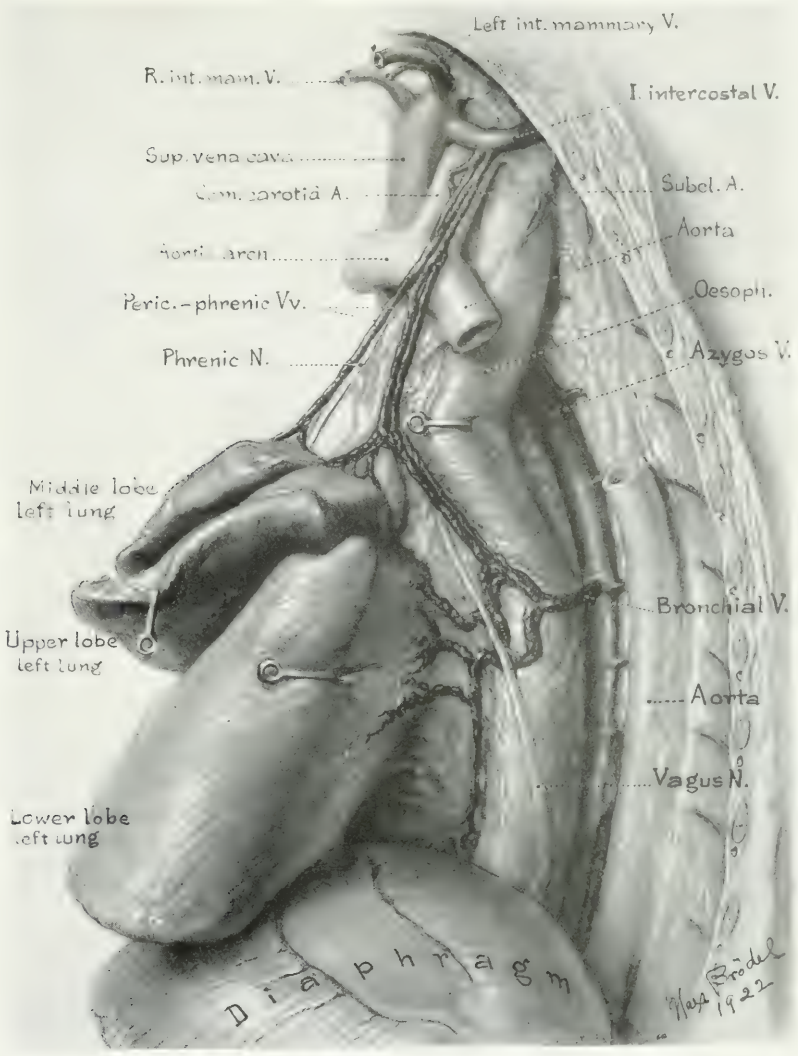

Fig. 4. Site of the left chest cavity in a dog 130 days after partial occlusion of the left pulmonary veins. Enlarged bronchial veins in communication with the enlarged pericardiaco-phrenic veins and with the œsophageal veins.

mothorax filling) purposes. When breaking up adhesions in the wall of a partial pneumothorax by elevating the pressure in the cavity, air embolism through these collaterals may occur (Zink). But also in other chronic inflammatory conditions (abscess, bronchiectasis) the same precautions are indicated, to prevent sudden, serious complications due to air embolism (puncture). During pneumolysis, pneumotomy, and pneumectomy we have always to face the possibility of the existence of these collaterals as a complicating factor. Beneke's case illustrates very well the clinical features of an air embolus of this type. The main danger in these operations is air embolism through the pulmonary veins and the left heart, as described exhaustively in my monograph on the intrapleural reflexes (17). The knowledge of these two sources of complications in various intrathoracic operations allows the surgeon to prevent the occurrence of air embolism by taking special precautions when

working in certain localities of the lung surface—those adherent to the chest wall or to the mediastinum. Preventive therapy is best. When confronted with an air embolus, stop the operation immediately; pack the wound thoroughly; lower the head and thorax (Trendelenburg position) so that the place of injury is situated below the level of the heart. This diminishes at the same time the danger of an air embolus into the brain. Stimulants may be used to strengthen and reinforce the heart action. Puncture of the right auricle and aspiration of the air, as advised by Delore (18), will prove very efficacious.

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DEPARTMENT OF TECHNIQUE

REDUCTION OF FRACTURES WITH THE FLUOROSCOPE

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THE majority of fractures, especially in the long bones, are associated with deformity at the fracture site. This deformity, as we know, is mainly due to the broken fragments being in an abnormal position, thrown there by vulnerating force and the muscle pull. As time elapses this deformity increases, due to the constant contraction of the unrestrained and irritated muscle. Meanwhile the associated hæmatoma undergoes organization, the exudate in the muscle bundles organize, tending to glue the bundle together and render the muscle less elastic and pliable. In other words, the earlier the reduction of a fracture, the easier it will be accomplished, for the natural position of the fragments is that of apposition. Furthermore, they will tend to stay in their reduced position much more readily if there is no tough, resisting blood clot filling up the fracture edges as well as the tissue space where the bone should be. The results of delay in reduction go even further than merely making reduction difficult. It will even decrease the chances of ultimate function. Femur shaft fractures, allowed to go 8 to 10 days unreduced will never be properly reduced except by open reduction. Now, as a proper reduction is easiest done early, and as our functional and anatomical results depend primarily to a great extent upon good reduction, it behooves us to accomplish this.

Fig. 1. *a* (above), First splint applied. The sterile dressing is laid back from the open wound and the fracture position inspected. *b*, Both splints applied.

Fig. 2. Mettledorpf triangle held with plaster-of-Paris bandage.

At present most fractures are rather neglected as regards efficient and early treatment. In private practice we are called to attend a recent fracture. The tendency is to attempt a reduction with or without an anæsthetic and, aided by a member of the family, a makeshift splint is applied. Or, if the case comes to the hospital there usually is a splint already applied and the resident physician looks it over, finds no glaring deformity and has the case sent to the ward to await an X-ray, which usually cannot be taken at once, especially if it is at night, a holiday or Sunday. In either case, the photograph if taken that day is not reported upon officially until the next day, so that the delay stretches from hours to a very likely 36 to 48 hours.

A second reduction, on a much swollen member, often now covered with blebs, is scheduled for the next day, and another X-ray to determine the corrected position is not heard from until the following day, bringing the delay up to 2, 3, or 4 days before we really know the true position of the fragments. In other words, we have anæsthetized twice, traumatized twice, and possibly wasted 2 to 4 days, all in a haphazard *blind* attempt to accomplish reduction. Then, in many instances, we are forced to do open reduction.

How much better if we would *promptly* use a fluoroscope for our reduction and not only feel but *see* that the replacement is correct.

It is perfectly true that a hospital and a fluoroscope is not always available, yet it is much easier to reach one in these days of medical enlightenment and standardized hospitals, than one would at first suppose. It is, of course, understood, that many fractures can be readily reduced and the palpating hand assures us that the position is all right. But how often have we been sure of an excellent reduction, only to find by X-ray later that the position is anything but good.

Today on the writer's services at the University of Pennsylvania and Howard Hospitals, all fractures are treated with the idea of promptness and direct vision reduction when indicated. A fracture is an emergency and is so treated. If shock

Fig. 3. *a* (above), First stage of dressing for open reduction of tibia and fibula fracture. The sterile dressing is laid back from the open wound to permit inspection of the fracture site. *b*, The second splint is applied and molded ready to be bandaged upon the limb.

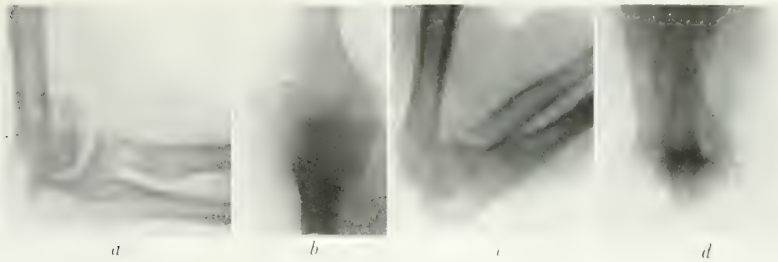


Fig. 4. Case 1. *a* and *b* were taken after second attempt at reduction; *c* and *d*, after fluoroscopic reduction.

exists that patient is given morphia, heat and fluids. The broken limb is slowly and gently placed in its position of muscle equilibrium or balance and weight traction with adhesive applied in the long axis of the broken bone. For the extremities, the Thomas arm and leg splints are the best. Unless the bone is subcutaneous, no effort is made at a formal reduction, until the X-ray is available.

At the earliest possible time the patient is taken to the fluoroscopic room and anæsthetized, preferably etherized, as ether is more easily administered in the dark with only a hand flash for light. Ether also gives better relaxation. If one does much of this work under the fluoroscope, it is well to wear leaded rubber gloves and apron. It is equally important from the patient's standpoint that your roentgenologist does not allow overexposure during prolonged endeavors. All manipulations do not demand the rays. A glimpse now and then is all that is needed. In fact, many of the cases can be reduced before using the ray at all except for confirmation of position.

When the patient is thoroughly relaxed, the limb is placed in its position of muscle balance, which is, for forearm fractures, with a partially flexed elbow and the hand in the mid position between pronation and supination; for humerus fractures, with elbow partially flexed and arm abducted; for femur fractures, thigh and leg flexed, thigh 45 degrees and leg 90 degrees; and for leg fractures, the limb on the outer side, and the thigh and leg flexed, at about the angles mentioned above.

As one becomes a little experienced in this method of reduction, he will find that there are many little tricks and twists that will help to render reposition easier. In Colles' fractures, traction avails but little. Angulation backward

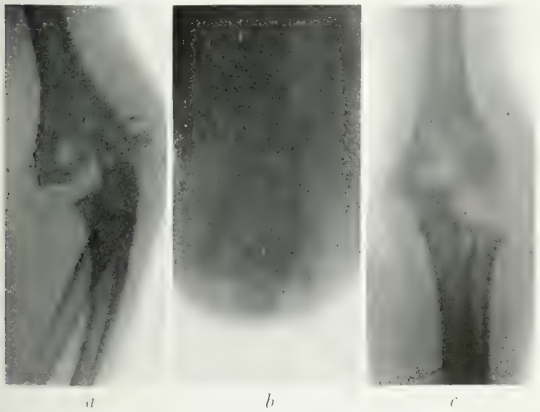


Fig. 5. Case 2. *a* was taken after one attempt at reduction; *b* and *c*, after fluoroscopic reduction.

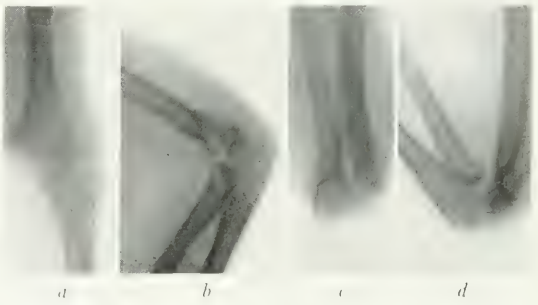


Fig. 6. Case 3. *a* and *b* were taken after one attempt at reduction; *c* and *d*, after fluoroscopic reduction.

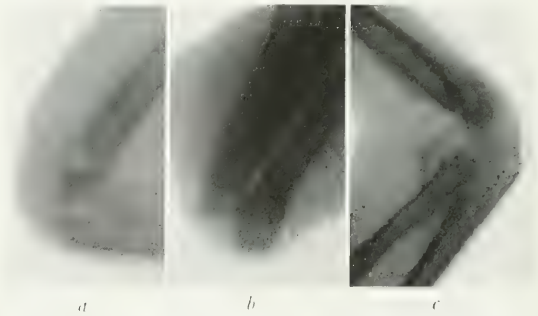
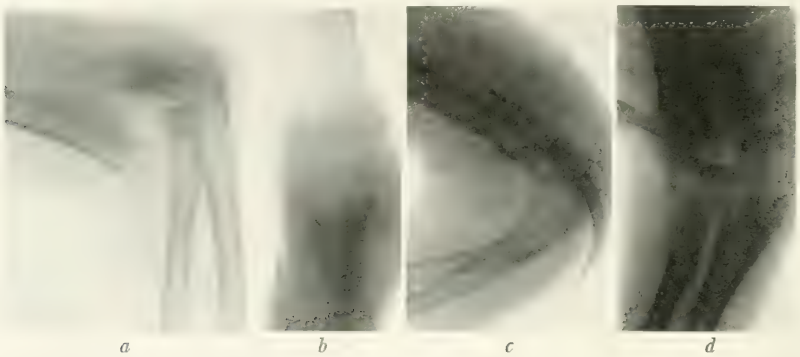


Fig. 7. Case 4. *a* and *b* were taken after fluoroscopic reduction; *c* shows a bony bridge which had formed and was broken while the physician was giving passive motion and massage.

a *b* *c* *d*

Fig. 8. Case 5. *a* and *b* were taken after one attempt at reduction; *c* and *d*, after fluoroscopic reduction.



a *b* *c* *d*

Fig. 9. Case 6. *a* and *b* were taken after two ordinary and one fluoroscopic reduction attempts; *c* and *d*, after open reduction.

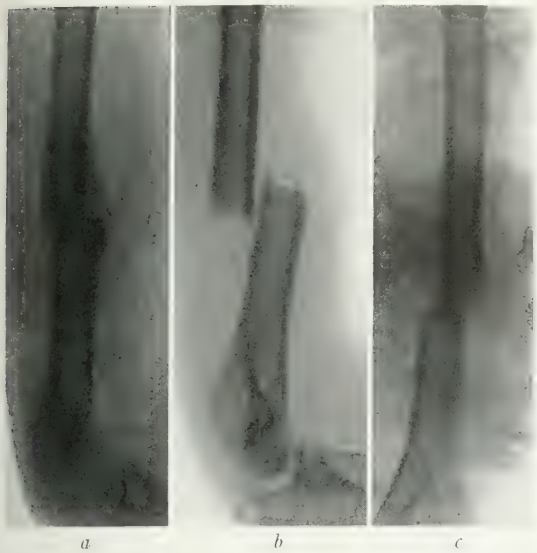
to as near a right angle as possible, forcibly, pressure downward on the lower fragment with the thumb of one hand holding above the wrist, the other hand grasping the patient's hand and bending it forcibly to the ulna side, at the same time internally rotating, as it is straightened out on the wrist, an assistant meanwhile making counter traction at the elbow, usually results in reduction.

If this corrects the overriding, the patient's hand is carried into a position of about 25 to 30 degrees flexion, at the same time abducted toward the ulna. A palmar plaster molded splint is applied reaching from the elbow crease to the metacarpophalangeal joints. The splint is held in place by a gauze bandage. Again the fluoroscope is used and any additional molding of the parts is accomplished as the splint hardens. A similar posterior splint is applied (Fig. 1).

If both bones of the forearm are broken near the lower extremity, it may be necessary here also to bend the hand backward to nearly a right angle, in order to engage the broken edges to act as a fulcrum. If this fails, abduction sharply to ulna side is tried, in order to engage the radial fragments first, later using the reverse procedure to accomplish ulna reduction. Plaster splints are applied one at a time as above.

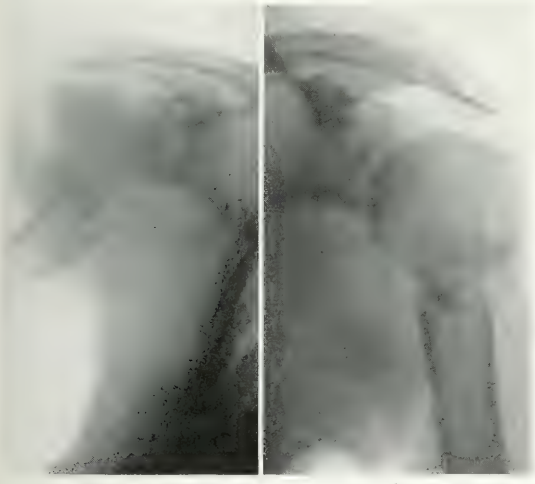
When the bones are broken farther up the shaft, traction, pronation, and supination and molding the ulna into position and endeavoring to hold it there with the thumb and forefinger, while the radius is reduced, gives the best results.

In fractures of the lower end of the humerus into and around the elbow joint, the earliest possible reduction should be accomplished, for these cases are prone to have excessive swelling, interference with circulation and later excessive callus formation in hæmatomata. This fracture is reduced in much the manner we would reduce a posterior dislocation at the elbow. The anteroposterior deformity is first reduced, the forearm



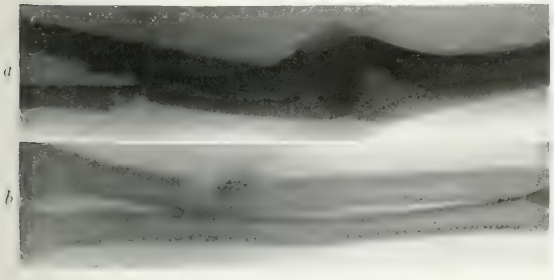
a *b* *c*

Fig. 10. Case 7. *a* was taken after two attempts at reduction; *b*, after fluoroscopic reduction, and *c*, six weeks later.



a *b*

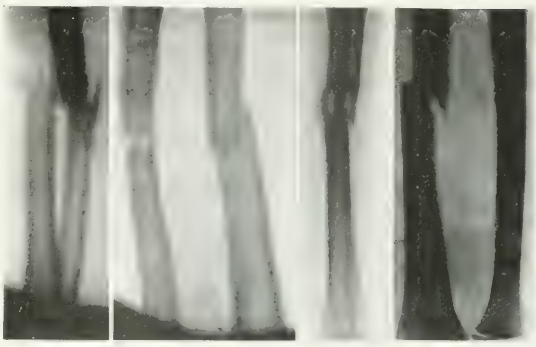
Fig. 11. Case 8. *a* and *b* were taken after one attempt at reduction; *c* and *d*, after fluoroscopic reduction.



a

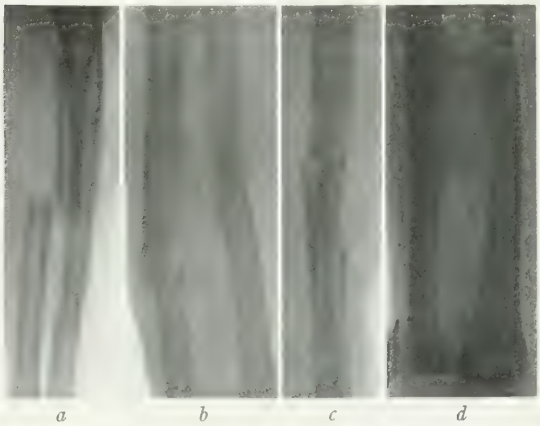
b

Fig. 12. Case 9. *a* and *b* show reduction under the fluoroscope.



a *b* *c* *d*

Fig. 13. Case 10. *a* and *b* were taken after one attempt at reduction; *c* and *d*, after fluoroscopic reduction.

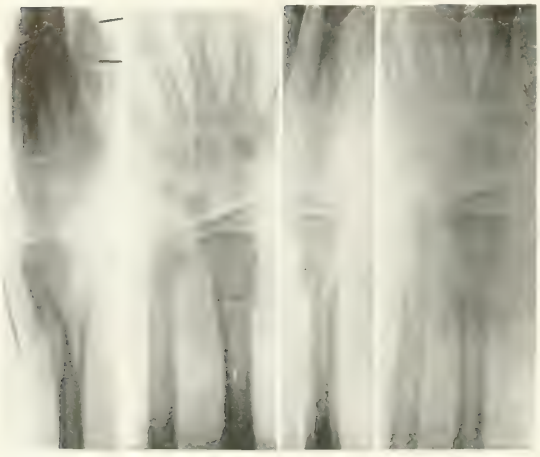


a *b* *c* *d*

Fig. 14. Case 11. *a* and *b* were taken after one attempt at reduction; *c* and *d*, after fluoroscopic reduction.

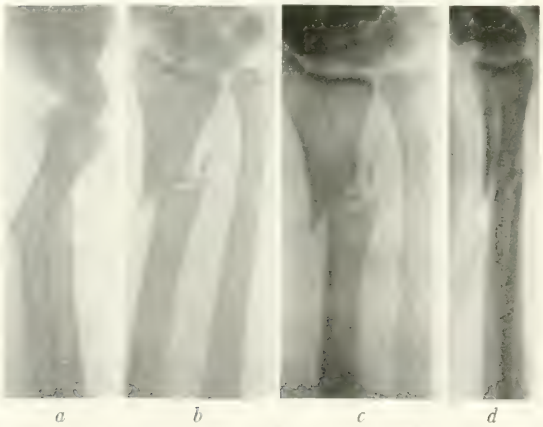
a *b*

Fig. 15. Case 12. *a* and *b* show position after fluoroscopic reduction.



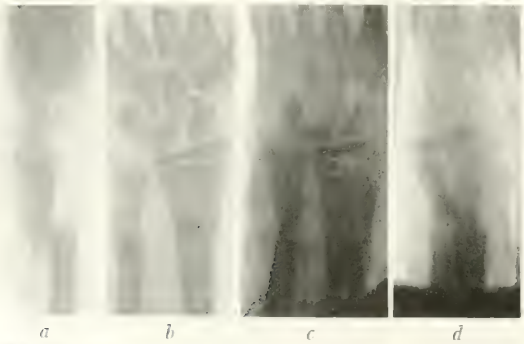
a *b* *c* *d*

Fig. 16. Case 13. *a* and *b* were taken after one attempt at reduction; *c* and *d*, after fluoroscopic reduction.



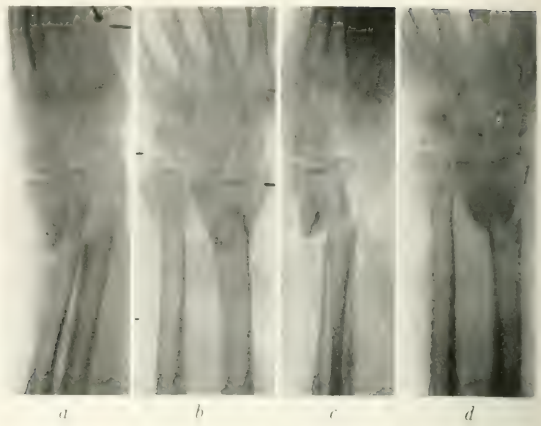
a *b* *c* *d*

Fig. 17. Case 14. *a* and *b* were taken after reduction and dressing on straight board splints; *c* and *d*, after reduction under the fluoroscope and fixation with plaster-of-Paris splints.



a *b* *c* *d*

Case 15. *a* and *b* taken after two attempts at reduction; *c* and *d*, after open reduction.



a *b* *c* *d*

Fig. 19. Case 16. *a* and *b*, Compound fracture after two attempts at reduction; *c* and *d*, after fluoroscopic reduction.

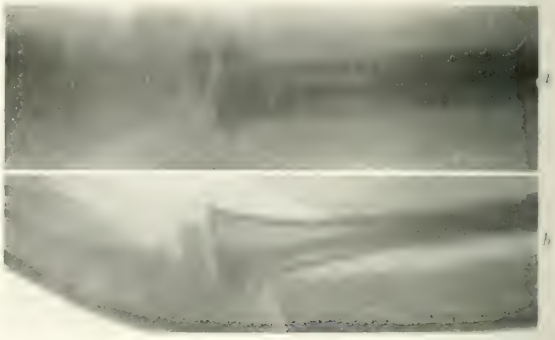
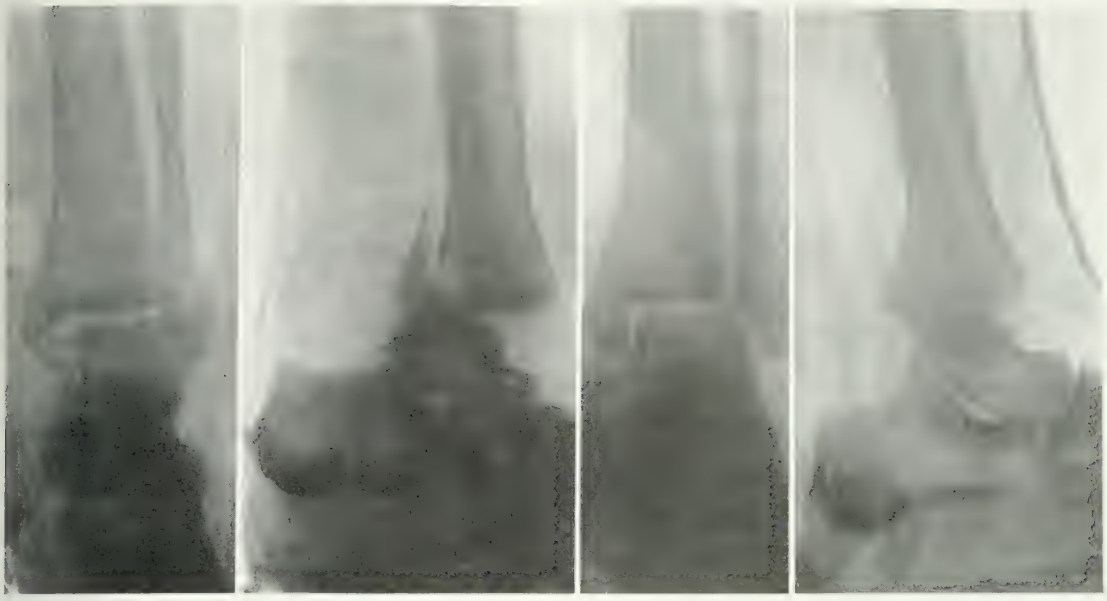


Fig. 20. Case 17. *a*, taken after second reduction; *b*, after fluoroscopic reduction.

flexed and the fluoroscope used with the arm and forearm abducted and in the plane of the supine patient's body. If this view is good, the limb is brought to the patient's side with the hand on the shoulder of the injured side and a look taken. Should there be lateral displacement, the forearm is extended to about a right angle and the lateral deformity corrected. In Y fractures into the joint, with wide separation, the fragments can be sometimes approximated by a Spanish windlass applied gradually for a few moments. The limb is dressed in the Jones position.

Fractures of the middle of the shaft of the humerus are best reduced by traction in the abducted position. A plaster-of-Paris splint is then applied from axillary fold to bend of elbow. As this hardens the limb is carried to rest on a previously prepared Mitteldorpf triangle. After fluoroscopic confirmation of the reduction, the entire limb is bound to the chest with plaster-of-



a *b* *c* *d*

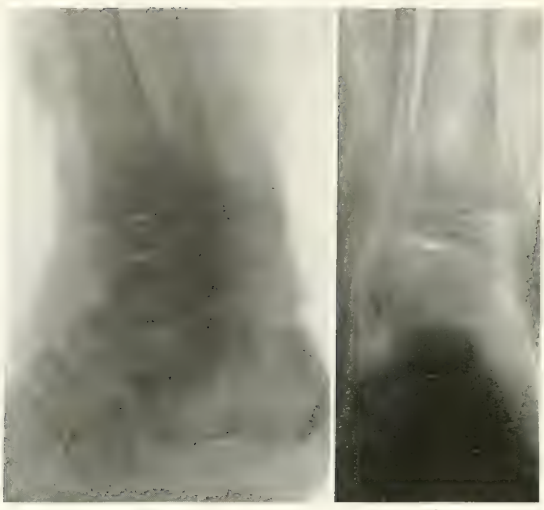
Fig. 21. Case 18. *a* and *b*, taken after second reduction; *c* and *d*, taken after fluoroscopic reduction.

a *b* *c* *d*

Fig. 22. Case 19. *a* and *b*, taken after one reduction; *c* and *d*, after fluoroscopic reduction.

Paris bandages, especial care being taken to give support to the elbow posteriorly, as sagging occurs here resulting in external bowing (Fig. 2).

In fractures of the surgical neck of the humerus reduction is obtained much as one reduces a dislocation of the shoulder by the Cooper method, using, however, the fist in the axilla in place of the foot. Very often it is necessary, in order to maintain reduction, to impale a sharpened process of one fragment into the spongy bone of the other fragment. Such a procedure was carried out in Case 8. This patient, seen 4 months later, had perfect motion and both shoulders are alike in contour. The arm and forearm are



a *b*

Fig. 23. Case 20. *a* and *b*, taken after fluoroscopic reduction.

bound to the side with a pad in the axilla, and the fluoroscope again used.

Fractured femur cases do not lend themselves to this method except in fractures in youngsters that can be encased in plaster in the flexed position, Case 21, or in adults in which the line of fracture is more or less transverse, at least enough so to enable partial end-to-end locking of the fragments. These last-mentioned cases should be supported at once with a Thomas or Hodgen splint, and bone traction with tongs, or by means of adhesive if practical, applied before the last fluoroscopic view is taken.

In fractures of both bones of the leg, reduction is accomplished with the thigh and knee flexed and lying on its outer side, with traction on the foot by a Collins' cinch and counter traction at the knee. If the fragments engage somewhat, the limb is gradually straightened until the knee has but 10 to 15 degrees flexion. The fluoroscope is again used, an external lateral plaster splint is applied from mid thigh down to and around the foot. As this hardens, the fracture site is watched while traction on the Collins' cinch is relaxed. If the position holds, the internal splint is applied. One case of fracture of the upper end of the tibia running into the joint and with separation of the fragments, was reduced by means of the encircling Spanish windlass, compressing the parts until the splints were applied (Case 19). X-ray views are taken, preferably stereoscopic, of all cases after the splints become hardened.

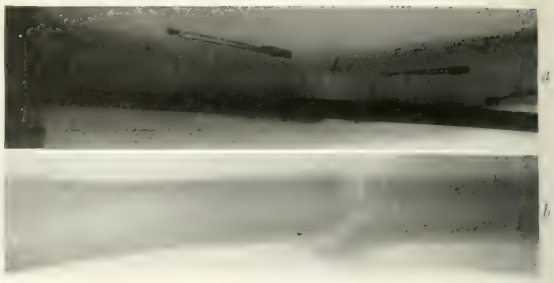


Fig. 24. Case 21. *a* and *b*, taken after fluoroscopic reduction.

Many cases are not reducible and many, though reducible, cannot be held. Unless contra-indications exist, these cases are reduced by the open method as soon as the decision is made. Many times, in forearm and leg fractures, we can dispense with internal fixation after open reduction. Where the fragments can be interlocked the wound is temporarily left open and covered by a sterile dressing and bandage. A lateral plaster splint is applied escaping the incision. After this is hardened the sterile dressing is turned back and the fracture site inspected, the limb being moved so as to demonstrate any motion that might exist at the fracture site (Fig. 3). If all is satisfactory, the wound is closed and protected and the other lateral splint applied. But should the reduction not be maintained, internal fixation is used.

The accompanying roentgenograms show some cases in which reduction had failed one or more times, but was subsequently accomplished by direct vision. In a series of approximately 50 cases, including femur, tibia, and fibula; humerus, radius, and ulna, but two required open reduction, one a supracondylar fracture of the humerus with interposition of the musculospiral nerve and other soft tissue, the other a fracture at the lower end of the radius and ulna in which the ulna could not be reduced.

Case 1. Figure 4, *a* and *b* taken after a second attempt at reduction; *c* and *d* taken after fluoroscopic reduction.

Case 2. Figure 5, *a* taken after one attempt at reduction; *b* and *c* taken after fluoroscopic reduction.

Case 3. Figure 6, *a* and *b*, taken after one attempt at reduction; *c* and *d*, taken after fluoroscopic reduction.

Case 4. A film was not made of this case showing the deformity existing after the first reduction. It was observed through the fluoroscope and the usual lateral and anteroposterior displacement noted. Figure 7, *a* and *b*, were taken after fluoroscopic reductions; Figure 7, *d*, shows a bony bridge that formed and was broken by the physician while giving passive motion and massage.

Case 5. Figure 8, *a* and *b*, taken after one attempt at reduction; *c* and *d* taken after fluoroscopic reduction.

Case 6. Figure 9, *a* and *b*, taken after two ordinary and one fluoroscopic reduction attempts. It was found

impossible to engage the fragments and open reduction was decided upon. At operation the musculospiral nerve and other soft tissue were found between the fragments.

Figure 9, *c* and *d*, taken after open reduction.

CASE 7. Figure 10, *a*, taken after two attempts at reduction; *b*, after fluoroscopic reduction; *c*, six weeks later.

CASE 8. Figure 11, *a*, taken after two attempts at reduction; *b*, taken after fluoroscopic reduction.

CASE 9. This case showed under the fluoroscope a dislocation of the head of the radius and a comminuted fracture of the ulna with about one inch overlap. No film was taken.

Figure 12, *a* and *b*, show the reduction under the fluoroscope.

CASE 10. Figure 13, *a* and *b*, taken after one attempt at reduction; *c* and *d* taken after fluoroscopic reduction.

CASE 11. Figure 14, *a* and *b* taken after one attempt at reduction; *c* and *d* taken after fluoroscopic reduction.

CASE 12. Viewed under the fluoroscope after attempted reduction, this fracture showed a half-inch overlap in both bones.

Figure 15, *a* and *b*, show the position after fluoroscopic reduction.

CASE 13. Figure 16, *a* and *b*, taken after one attempt at reduction; *c* and *d* taken after fluoroscopic reduction.

CASE 14. Figure 17, *a* and *b*, taken after one reduction and dressing on straight board splints. The dislocated ulna permitted the angulation of the radius. *c* and *d*, after reduction under the fluoroscope and fixation with plaster-of-Paris splints.

CASE 15. Figure 18, *a* and *b*, taken after two attempts at reduction; *c* and *d* taken after open reduction, fluoroscopic reduction having failed on the ulna.

CASE 16. Figure 19, *a* and *b*, a compound fracture after two attempts at reduction; *c* and *d* taken after flurororoscopic reduction.

CASE 17. Figure 20, *a*, taken after a second reduction; *b*, taken after fluroscopic reduction, where it was seen that the reduction was very easy but slipped with a straight splint dressing. A molded plaster splint with the wrist flexed held the fragments.

CASE 18. Figure 21, *a* and *b*, taken after second reduction; *c* and *d* taken after fluoroscopic reduction.

CASE 19. Figure 22, *a* and *b*, taken after one reduction attempt; *c* and *d* taken after fluoroscopic reduction, and the aid of a Spanish windlass compression.

CASE 20. This case had marked lateral displacement due to an incomplete fracture of the fibula and an epiphyseal separation and fracture of the tibia. No film was taken.

Figure 23, *a* and *b*, taken after fluoroscopic reduction.

CASE 21. This case had overlapping of 2 inches (femur). Figure 24, *a* and *b*, taken after fluroscopic reduction.

Many other illustrations could be presented but space does not permit. The above were consecutive cases that had had one or more attempted reductions by various physicians before they reached our hands.

SUMMARY

1. Fractures should be treated as emergencies.

2. Reduction, with fluoroscope if necessary, as early as possible, theoretically at least should give the best results. Economically it certainly saves time and expense.

3. It lessens the number of open reductions.

4. By this method of splint application, internal fixation material can often be omitted in open reduction cases.

5. The drawbacks to the use of the fluoroscope are the dangers to the physician and patient from over exposure to the rays and explosion of ether by open spark if the ether is not removed.

CONGENITAL FACIAL CLEFTS[1]

By V. P. BLAIR, M.D., F.A.C.S., St. Louis

MORE than half a century elapsed after the enunciation of all of the basic principles essential to the closure of the congenital facial clefts, before the palate operation was a success. The early technical results were probably as perfect as they are today, but not so regarding function.

The surgery of the lip is inseparable from that of the palate. From the more available data, a résumé of the appearance of the various essential steps would read about as follows:

According to Velpeau (21), Celsus and other ancient surgeons pared and sutured the hare-lip and made relaxation incisions on the inner surface of the cheeks. Later the art was lost and even in the eighteenth century escharotics, plasters, clamps, and bandages were still substituted for the rational technique of the ancients.

In 1825, Pointe (21), of Lyon, and Mannoir (21), of Geneva, reiterated the recommendation of Franco in 1561 that previous to the closure of the lip cleft, the posterior surfaces of the two halves of the lip be separated from the bone as far back as the cheeks.

Velpeau (21) recognized that the requisites for cure of a hare-lip are abrading of the borders, and maintenance of perfect contact. He reviewed and condemned the various types of clamps that were used to hold the lip while it was being pared.

The younger Husson, in 1836, recommended that the denuding incisions be made concave. His modification and also the flap operation described by Mirault (14), in 1844, permit of proper adjustment of the ala and floor of the nostril, and at the same time give the fullness at the lower part that reproduces the pyramidal form of the normal upper lip. Other operators have substituted an angular for the curved incision, and certain details in the Mirault operation have been changed (4), but in each of the two plans the underlying principles have stood the test of time. The Mirault type is a little more difficult, technically, but by it even the "cupid's bow" can be reproduced. The Husson type with either the curved or the angular incision is the popular operation of today, but it is apt to make an abnormally long lip. Either of these two types can be adapted to the repair of double or incomplete lip clefts. B. Bell recognized the necessity of extending the incisions up to the nostril in incomplete lip cleft.

Almost every possible kind of supplementary support, or even substitutes for sutures, have been suggested. Among the former, the quill suture which comes from a very early date, the perforated ivory plates (analogous to the lead plate suture) used by Van Onsenort, and a supplementary support of threads crossing the suture line and attached to pieces of adhesive plaster on each cheek as used by Roux are worthy of note (21).

Obturators for the closure of a cleft palate may have been used by the Greek physicians, as stated by Guillemeau, but it is an historic fact that Ambroise Paré described such a contrivance in 1541. Paré's publication, however, was antedated a few years by one Alexander Petronius. The first artificial palate was made by M. Delabarre, in 1820. According to Kingsley, the palate described, in 1841, by Dr. Stearn, of Springfield, Massachusetts, embodied the true principle that rendered available the muscles of the natural palate to control the movements of the artificial palate (11).

The earliest available record of successful repair of a cleft velum was by Lemonnier (22), a French dentist, published in 1766. Eustache (22), of Beziers, in 1784, proposed the feasibility of surgical closure of cleft palate, but no evidence was found to show that he put his idea into actual practice (22).

Dieffenbach (5), in 1834, reported first the operation for the cure of a cleft involving the hard and soft palate. It was done by liberating mucoperiosteal flaps through laterial incisions made close to the alveolar process. After freshening the cleft borders, the flaps were sutured at the mid line. Baizeau (22), in 1858, and von Langenbeck (22), in 1861, claimed originality for this operation. Today it bears the name of the latter surgeon. While neither of these two was the first to do the operation, both Baizeau and von Langenbeck helped to popularize it.

In 1842, J. Mason Warren (23), of Boston, reported several cases of cleft of the hard and soft palates cured by mucoperiosteal flaps raised and sutured without making the lateral incisions of Dieffenbach. The fact that an American, T. D. Mutter (15), in 1843, reported 21 operations on the hard and soft palate done by Warren's method, leads one to believe that Warren or Mutter had used this plan for some time before its publication

[1] It is generally believed that previous to 1834 practically all these operations were confined to the soft palate but according to Robert (1) Lemonniere [illegible] of a child in whom the cleft "extended from the velum to the incisor teeth." However, the technique ascribed to Lemonniere by Robert in no way reflects the broad underlying principles later utilized by Dieffenbach and Warren, and one feels that he must have been somewhat the beneficiary of beginner's luck.

in 1842. Warren's operation is now used by a number of American surgeons. Dieffenbach's, under the name of the von Langenbeck operation, is the one in more general use, and the lateral incisions, which should be made without cutting either muscles, nerves, or the posterior palatine vessels, relax the flaps and serve as convenient avenues for packing in case of persistent bleeding.

Dieffenbach in 1834 also advocated cutting the palate muscles for relaxation (5), and in 1826 (12, 6) did osteotomy of the palate process with mid line suture as a means of closing a palate cleft. Both of these procedures are usually credited to Sir William Fergusson (9, 10) who published each at a subsequent date. Billroth, in 1861 (18), substituted fracture of the hamular process for cutting of the tensor palati tendon.

Blasius (17) attempted to close a congenital cleft of the palate by a pedicle flap taken from the forehead and failed. His idea was later successfully carried out first by Thiersch (20), who in 1867, closed an acquired defect by means of a flap taken from the full thickness of the cheek, and later by Rotter (17) who, in 1889, reported a case in which he closed an anterior palate defect by a flap turned from the forehead which he had previously "Thiersch" grafted on its under surface. Kuster (13) included a part of the mucosa of the cheek with his palate flap.

E. Dudon (7, 8), of Bordeaux, credits Sedillot with the idea of the use of tapes drawn through the lateral incision for support to the palate, but Dudon used them in 1887 without suturing the freshened borders (7, 8). Fergusson passed wires around his osteoplastic flaps (10).

Adaptations, variations, and improvements have come with use, but, with one notable exception, it is doubtful if a single broad principle advantageously applicable to the unoperated on cleft of the lip or palate in the infant has been established in the past half century, and the exception noted is not related to technique. There is reason to believe that the technical results obtained by some of these earlier surgeons were quite as good as those of today. Velpeau (21) states in regard to hare-lip operations that the present practice seems to have nothing to be desired and in 1843 Mutter (15) out of 21 cases of cleft of the hard and soft palate, reported 19 successes by the Warren technique. The adjustment shown in Smith's *System of Surgery* of 1852 (19), illustrating the Mirault operation for hare-lip, appears to be quite logical, which is more than can be said of many of the operations we find illustrated since that time. It is not to be forgotten that these operations were done on children, without an anæsthetic.

The operative mortality of these operations would compare favorably with the best of today. South's (1) commentary is that "he thought the operation of staphylorrhaphy is generally unattended with danger, yet in a few instances it has been fatal." Roux lost 1 case out of 60 operated by "an inflammation spreading to the lungs and Bernard lost 1 case from pneumonia."

Our present functional success in palate operation comes not from new technical principles, but from adaptation to age.

At birth not much of the lip or palate tissue is actually missing, the width of the cleft being dependent upon a spreading apart of the two maxillæ. This was recognized by the earlier surgeons who at times used bandage or clamp pressure on the cheeks or direct pressure on the dental arches pre-operatively to narrow a cleft (21), but usually they were content to repair the lip over the cleft. This is followed by approximately normal relations of the bones, and except in the immediate proximity of the alveolar cleft, average occlusion of the teeth.

In 1861, Reeves (16), of Melbourne, advocated the very early use of a clamp on the gums to obliterate the maxillary cleft, but it is not evident that he carried out this practice. The elder Sayre discussed such a possibility in his clinical lectures.

More radical measures have not proved entirely fortunate. Lane used wide Davies-Colley flaps (2, 3) on the very young infant, while Brophy taking advantage of the pliability of the bones at this age forcefully closed the alveolar cleft and narrowed the anterior part of the palate cleft by transfixing the maxillæ with wires and twisting them over lead plates. Both of these procedures disturb at least the deciduous teeth and are apt to disarrange the permanent occlusion which we now know may be followed by very serious consequences.

The Lane operation is no more certain of success than the Warren or von Langenbeck when done at the proper age and when failure follows the primary Lane operation, re-operation is much more difficult.

Even the simple approximation of the alveolar process with a wire or suture through the bone, or the more radical plan of cutting or fracturing the process and replacing the premaxilla are followed by mal-relation of the incisor arches with flattening of the lip and increased difficulty of closing the anterior part of the palate cleft. Wiring of the maxillæ is sometimes followed by most distressing distortion and lack of develop-

ment of the upper jaw. These changes are rarely very evident in early childhood, but when seen at the age of 12 or 15 years may cause the operator almost to regret that this particular child was not one of those infants the angels had chosen for their own.

Cutting of the septum followed by overzealous replacement of the protruding premaxilla in the complete double cleft is frequently followed by results only less distressing than the catastrophe that can follow the wiring of the maxillæ. With the exception of the cutting of the septum in the complete double cleft, any and all cutting or suture of the bone is unnecessary as it is inadvisable.

The practice of simply repairing the lip over the open alveolar cleft is again becoming increasingly popular. The earlier this is done the better, though many operators prefer to wait until the child is 3 months old. In from 3 to 15 months following this operation the borders of the alveolar cleft will usually have come in contact, giving a better ultimate occlusion than can be produced by direct suture of the bones themselves.

The difficulty of preserving the normal contour of the nostril when the lip is made to bridge a wide cleft can be largely overcome by the proper application of a lead plate suture, or if the child first comes to operation after 2 years of age, the alveolar borders can be first approximated either by an orthodontic appliance as advocated by G. V. I. Brown, or by a primary repair of the palate cleft. Such mal-adjustment of the lip-nostril as does occur can be corrected by subsequent operation which is very much less true of the bone deformities that may follow wiring operation.

Among the earlier surgeons, the time of election for the palate operation was about 12 years, for at that time a desire for relief had been aroused within the patient and he was more apt to cooperate. The operation at this time improves both comfort and health, but it is usually a signal failure in one most important particular—it rarely restores normal speech. The average staphylorrhaphy done at this age might be compared to an imperfect restoration of a bottomless bucket, which makes it fit for carrying solids but not liquids; the human voice is essentially liquid. This led Kingsley, in 1879, to state that staphylorrhaphy was a failure and that mechanism was more reliable than surgery.

While at birth there is little of the normal tissue of the lip or palate missing, it is not long afterward, however, that more serious deviations become increasingly evident. One of these is the relatively shortness of the cleft velum which, failing to make contact with the pharyngeal wall, is almost entirely responsible for the "cleft palate speech."

Mutter (15) advocated early operation for both lip and palate but in this he had no following.

It was Wolf (24) in Germany, Lane, in England, and Brophy, in America, who breathed into the operation the life that brought it to its present general success. They established the fact that the cleft palate should be closed before the age of 2 years. Then the length is usually not too disproportionate and a good technical repair with subsequent training should give a fair approximation of average speech.

While the possible ill results that may follow must necessarily lead to the ultimate discard of the more radical operations, it was these same operations that demonstrated that functional results will follow the early closure of the palate cleft and this places their authors, along with Lemonniere, Malgaigne, Husson, Mirault, Warren, and Dieffenbach as among the founders of modern palate and lip surgery.

In our summing up, we should not overlook the part contributed by those professional teachers of elocution who have by gymnastics of the throat muscles done their share to improve function. Among these, Gutzmann later reversed Kingsley's judgment by concluding that the palate operated upon is a better foundation for speech training than the artificial palate.

The real problem in palate surgery before the surgeon today is a simple effectual plan of lengthening the velum, especially at the late operation. Several remedial types of operation are now being worked upon, but it would seem that, to date, none is entirely satisfactory. Correction of the mal-position of the ala and nostril which develops in the unoperated upon or the mal-operated upon lip is another problem that is now receiving attention.

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RUPTURE OF THE URETHRA

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THE recent observation of a rather unusual case of traumatic rupture of the urethra prompted the author to look into the subject more extensively, and there was found a decided scarcity of material in the available recent literature. We personally remember having seen at least four cases in the last 3 or 4 years, so that it is our impression that the condition is not as infrequent as some authors would have one believe. Reference is not made here to reports of injuries of a previously pathological urethra. We limit our discussion to traumatizations of the urethra in cases where pathology antedating the time of injury was presumably not present.

An interesting phase of this subject is a consideration of the etiology and the mechanics of the production of the rupture. As is generally understood, the vast majority of traumatic tears of the urethra are due to direct violence. Thus, the most common cause is falling astride some object. Under such circumstances there may or may not be a concomitant fracture of the pelvis. The fact that the pelvis is fractured, may have an important bearing on the etiology of the urethral tear. It is not difficult to conceive of a fracture of the pubis or ischium with displacement of the fragments, the irregular end of one of the fragments tearing through the urethra. Allison reports such a case in some detail. The majority of ruptures through the perineo-bulbar portion of the urethra due to direct violence are unaccompanied by pelvic fracture. The mechanism in these cases consists of the impaction of the urethra against the superimposed pubic arch, although it is Cras' belief that the bony structure involved here is the ischiopubic ramus. Dixon is responsible for the statement that practically all tears of the membranous portion are accompanied by fracture of the pelvis or dislocation at the hip, implying very plainly that the pelvic or hip injury causes the rupture. We cannot subscribe to this, inasmuch as the majority of the reported cases of rupture of the membranous urethra were unaccompanied by such injury.

In cases due to direct violence, there may be an injury to the skin and subcutaneous tissues of the perineum, with the production of what may be termed a "compound" rupture. Thus, falling astride a sharp-edged object could easily produce such a lesion.

On the other hand, injuries due to indirect violence are rare and the exact mechanics involved cannot be explained with such ease. We were able to find only one report of an authentic case of urethral rupture from indirect violence. That one is cited by Harris, but, unfortunately, is not described in detail. The case reported herewith belongs to this category. In the absence of fracture of the pelvis and impaction against the superimposed bony framework, strong muscular contraction must be considered as the important, if not the sole, factor. From a careful study of the musculature of the perineum, it would seem plausible to assume that the concerted contraction of the muscles inserting into the central tendon of the perineum could in all probability cause an urethral tear, especially if the compressor urethræ muscle acts at the same

time. Here the central tendon presumably functions as a fixed point. That, we believe to be the mechanism in the case reported.

The symptomatology is easily understood when one remembers the underlying pathology. There is pain referred to the perineum, sometimes radiating toward the glans penis. When bladder distention becomes marked, there is considerable pain in the lower abdomen. Objectively, there is usually a hæmatoma of varying size in the perineum, with ecchymosis in the scrotal and thigh regions. The resulting ecchymosis may sometimes spread over a surprisingly large area. In addition, there is usually bleeding from the meatus of the urethra, which can be accentuated by slight pressure over the perineal hæmatoma. The degree of bladder distention will depend upon how soon after the injury the patient is examined. In the great majority of instances the patient is, of course, unable to void. Occasionally, however, this is not the case. Thus, Cotton reports an instance where the patient was able to void, in spite of the fact that he was passing blood *per urethram*. In this case he assumed the presence of an incomplete tear and did not operate, as he was able to pass a catheter which he left *in situ* for 5 days. A perfect result was obtained.

In cases seen late, extravasation of urine may have already occurred. The area involved by the extravasation will depend upon the site of rupture. When the tear occurs at the junction of the perineo-bulbar and membranous segments, the urine enters the superficial intra-aponeurotic space of the perineum, passes into the scrotum and thence over the body of the pubis, between the spine of the pubis and the symphysis, into the abdominal wall by way of the scroto-abdominal passage. Owing to the density and attachments of the deep layer of the superficial fascia of the perineum, there will be little or no fluctuation. Tears of the membranous urethra will result in an extravasation between the two layers of the triangular ligament. The deep layer may rupture and the extravasation will then involve the pelvic fascia. The latter complication is fortunately infrequent. Perineal, scrotal, or pelvic extravasations of urine, when not relieved within a reasonably short space of time, invariably become infected to be followed in succession by necrosis, sloughing of the soft parts, spreading of infection and sepsis. The possibility of the development of these serious complications seems to be the strongest argument for immediate operation on any case where rupture of the urethra is suspected or diagnosed with certainty.

Ever since Toulon in 1757 first performed retrograde catheterization, there have not been any marked advances in the treatment of this injury. Toulon's case, cited by Chopart, is most instructive. A sailor was admitted to his service after having fallen astride a mast. The surgeon vainly tried to pass a sound, even after perineal incision. He then punctured the bladder and introduced a cannula. This was left *in situ*. A few days later he introduced a catheter through the cannula to the neck of the bladder and protruded it through the perineal wound. This catheter served as a guide for the sound which was passed into the bladder and allowed to remain. Three months later the sailor was discharged cured. Similar cases, involving the procedure of retrograde catheterization after preliminary suprapubic puncture, were reported by Souberbielle in 1813. Fine, of Geneva, in 1809; Gordon Buck, of New York, in 1843; Chassaignac, of Paris, in 1844; Guersant in 1847; Brainard in 1849; Giraldès in 1867. Péan was the first to perform a suprapubic cystotomy (larger wound) for this procedure. Neuber, in 1880, first passed a sound retrogradely.

A review of the more recent case reports causes considerable uncertainty as to what constitutes the most rational treatment of these urethral injuries. Irrespective of what procedure is carried out, any case presenting the symptoms of inability to void, perineal hæmatoma, bladder distention, and urethral bleeding should be considered an emergency and operated upon as soon as possible. In cases with this group of symptoms, we can only condemn any attempts at preliminary catheterization. This syndrome is almost always accompanied by either a completely divided or an almost completely divided urethra. Attempts at catheterization increase the trauma, create false pockets in the perineum, cause fresh hæmorrhage and might easily produce a complete tear where an incomplete rupture previously existed. Preliminary catheterization should be reserved solely for those cases where the patient can void voluntarily. In such instances, there is apparently very little solution of continuity of the urethra. Successful catheterization here, of course, makes operative interference unnecessary. Cotton's case belongs to this group.

When considering the actual operative procedure, we do not believe it advisable to advocate a single method and make it applicable to every case. Thus, Harpster recommends preliminary suprapubic cystotomy. When the patient's general condition has improved, he then performs

perineal section. At the French Surgical Congress of 1910, Marion declared that preliminary diversion of urinary flow was absolutely indicated in urethral rupture. In contradistinction to this view, Allison maintains that suprapubic drainage is rarely indicated and should be used as a last resort for the sole purpose of performing retrograde catheterization.

After reviewing the various procedures advocated by a number of writers, we feel that a plan of action such as the following will result in a decrease in operative shock, a smoother and shorter convalescence, and better end-results. The first step, then, consists in making a vertical incision in the midline over the perineal hæmatoma. The blood clot is evacuated and all bleeding points ligated. It is sometimes exceedingly difficult to ligate the divided branches of the internal pudic vessels. A sound is then passed and the distal end of the torn urethra is located. An attempt is now made to locate the proximal end. It is desirable to carry out this procedure with great care and respect for the perineal tissues, inasmuch as false passages are very easily created. If the proximal end cannot be found after a reasonable search, the following manœuvre should be carried out. An assistant is instructed to apply constant gentle pressure over the bladder, and the surgeon, after thoroughly drying the operative field, watches for a trickle of urine in the lower part of the wound. Its point of exit marks the location of the proximal end of the urethra. This procedure was tried in the case herewith recorded, but without success, possibly due to the fact that it was difficult to obtain a perfectly dry field. If this manœuvre proves unsuccessful, the next step consists in performing a suprapubic cystotomy, primarily for bladder drainage, and secondarily for retrogade catheterization. If the patient's condition warrants it, retrogade catheterization can be performed at the first operation. The proximal end of the urethra is then easily located and sutured to the distal end over a large retention catheter. If the patient's condition is not good, it is advisable simply to drain the bladder and, 36 to 48 hours later, perform retrogade catheterization and urethral repair.

There are a few important points in the after-care of these cases that bear emphasis and repetition. The suprapubic and perineal wounds should be kept as clean as possible. Toward this end, it is advisable to change the dressings two or three times daily for the first few days after operation. We have found that tightly packing the suprapublic wound with vaseline gauze reduced the urinary overflow into the dressings to a minimum. In uncomplicated cases there ought not to be any seepage of urine through the perineal wound. Occasionally this occurs during the first 2 days after operation, but gradually stops without interference.

Another important phase in the after-care is the early institution of bladder irrigations. These should be repeated every 4 hours and given through the retention catheter, the washings passing out through the cystotomy tube. Sterile boric acid solution is most commonly employed. Only by these frequent irrigations is it possible to keep both tubes and the bladder clear of mucus and deposits of urinary salts. At the same time the chances for infection are greatly diminished. Of course, hexamethylenamine and, if indicated, acid sodium phosphate are given at regular intervals during the patient's convalescence.

As regards the time for removal of the retention catheter and the cystotomy tube, we believe each case should be judged individually. Where convalescence is smooth and the perineal wound is dry, the retention catheter can be removed on the ninth or tenth day. Allison left the retention catheter in place for 21 days, in spite of the fact that the perineal wound never leaked any urine. The suprapubic tube can be removed, 2 or 3 days after the indwelling catheter is dispensed with. As soon as the catheter is removed, the patient is encouraged to void voluntarily. The daily passage of sounds is instituted immediately, beginning at first with a No. 10 or No. 12 F. and gradually increasing the size. After the patient's discharge from the hospital, sounds must be passed at regular intervals, extending over a period of 6 to 10 months.

In tabulating end-results, anatomical, economic, and symptomatic factors must be considered. An analysis of the reported cases in the literature brought out the fact that very little attention was paid to economic and symptomatic end-results. Des Vignes and Larmande in the French literature have gone a little more fully into these questions. The economic factor, i.e., how soon a patient is able to resume his occupation and whether there has been any intereference with his earning capacity, we cannot enlarge upon inasmuch as very little has been reported. From the symptomatic standpoint, it is interesting to note that some of these patients complain of pain in the perineum, more noticeable during the act of micturition and lasting 6 to 12 months after the operation. If a stricture has developed, the accompanying symptoms of difficulty in voiding,

change in the caliber of the urinary stream, retention, etc., will be noted.

The question of anatomical end-results calls for a consideration of the presence or absence of stricture. There seems to be a concensus of opinion as to the advisability of passing sounds at regular intervals for a considerable time after operation. However, a careful study of some reported cases seems to bear out the old contention that, even in cases where regular passage of sounds is not practiced, stricture is less liable to follow a healed traumatism than a healed Neisser infection. The majority of the reported cases have been followed for 2 to 12 months with excellent anatomical end-results in a large percentage.

J. L., age 34, white, truckman by occupation, was admitted to the surgical service of Dr. Benjamin T. Tilton, at St. Mark's hospital, June 27, 1922, with the following history: Three hours before, he fell backward from the tailboard of a wagon to the ground, a distance of 3 feet, and landed on the broad of his back. As he was about to stand up, he saw a case of goods falling toward him, and, raising his right leg, kicked out strenuously against the falling object. He missed the case which fell harmlessly to one side. He stood up and proceeded with his work. Ten minutes later he began to experience pain in the perineum, accompanied by a desire to urinate. Instead of passing urine, he voided blood. On admission, he complained of pain and swelling in the perineum, inability to void, and bleeding from the urethra.

Examination, one half hour after admission, showed a well-developed, well-nourished male adult who complained of a constant desire to urinate. General physical examination was negative. By palpation and percussion, the bladder was found distended midway to the umbilicus. There was nothing to point toward intraperitoneal injury. There was a swelling in the perineum measuring 5 centimeters in diameter with ecchymosis over the entire perineum and lower half of the scrotum. There was free bleeding from the urethra, accentuated by slight pressure over the hæmatoma. No attempt at catheterization was made. Temperature 98° F., pulse 86, respiration 20.

Operation was performed immediately. Dr. J. H. Garlock. Under ether anæsthesia, a vertical incision was made in the midline over the perineal hæmatoma and the blood clot was evacuated. Three divided branches of the internal pudic artery were ligated with great difficulty. A sound was passed and the distal end of the torn urethra was easily identified, showing a raggedly torn edge. A search was then instituted for the proximal end. It could not be found. The procedure of gentle pressure over the bladder and watching for a trickle of urine, was unsuccessful. The perineal wound was packed with plain gauze and a suprapubic cystotomy was next performed, suturing a large cystotomy tube to the wound. Retrograde catheterization was not performed at this operation inasmuch as we felt that the patient's condition did not warrant it.

On the following day there was a bloody discharge from the perineal wound with marked scrotal ecchymosis. The cystotomy tube was draining freely. Temperature 105° F., pulse 120.

On June 29, 1922, 48 hours later, the second operation was performed. Dr. Benjamin T. Tilton. Assistant Dr. J. H. Garlock. Under gas-oxygen anæsthesia, the perineal wound was enlarged somewhat and the distal end of the torn urethra again identified. The cystotomy tube was removed and retrograde catheterization performed with a No. 22 F. sound. The proximal end was found greatly displaced from the midline toward the left and covered by torn muscle fibers, probably part of the compressor urethræ muscle. The tear had occurred at the junction of the perineobulbar and membranous portions of the urethra. It was then a simple matter to suture the divided ends over a retention catheter, size No. 24 F. No. 1 chromic interrupted catgut sutures were used, an attempt being made to obtain as accurate an approximation of mucous membrane to mucous membrane as possible. The perineal wound was packed with iodiform gauze and the cystotomy tube sutured back in place.

The patient showed a marked postoperative reaction with rapid feeble pulse and rise in temperature to 102° F. In 6 hours, after vigorous therapy, he had recovered from this surgical shock.

June 30. Both tubes draining freely. Perineal wound clean. Bladder irrigations started, using sterile boric acid solution. These were given every 4 hours through the urethral catheter, the washings passing out via the cystotomy tube. Temperature 101.8° F., pulse 110.

July 1. Condition satisfactory.

July 3. Mild superficial infection of the cystotomy wound. Perineal wound clean. Suprapubic wound packed with vaseline gauze to decrease the amount of urinary seepage around the cystotomy tube. Plain gauze packing in perineal wound.

July 5. Large cystotomy tube replaced by a smaller one. Superficial infection of wound. Perineal wound clean and granulating. There has been no evidence of urinary drainage from the perineal wound. Retention catheter draining. X-ray examination of pelvis negative for fracture. Urine: specific gravity, 1020; alkaline; very faint trace of albumin; few pus cells and some epithelial cells on microscopic examination.

July 10. Perineal wound practically healed. Retention catheter removed. No. 12 F. sound passed easily. Patient was urged to void voluntarily.

July 11. No. 20 F. sound passed without difficulty. Patient voided few ounces voluntarily today.

July 12. Cystotomy tube removed. No. 22 F. sound passed without meeting obstruction.

July 15. Condition satisfactory. Very little urinary discharge from suprapubic wound. Urine: specific gravity, 1008; alkaline; trace of albumin, few pus cells and many bacteria on microscopic examination.

July 17. Perineal wound healed. Suprapubic wound healing rapidly. Patient has been voiding since July 12. No. 24 F. sound passed. Urine: specific gravity, 1015; acid; trace of albumin; pus cells and bacteria.

July 19. Under local anæsthesia, meatotomy was performed in order to allow for passage of sounds of larger size. No. 28 F. passed without difficulty.

July 21. No. 28 F. passed easily. Suprapubic wound practically healed.

July 22. Urine: specific gravity 1016; acid; very faint trace of albumin; scattered white blood cells.

July 26. Discharged from hospital. Both wounds were healed and a No. 28 F. sound could be passed without meeting any obstruction.

Follow-up notes: The patient continued taking hexamethylenamine for 3 weeks following his discharge. Sounds were passed every 2 weeks for 2 months, at the end of which time a No. 30 F. was passed without difficulty. From then on sound therapy was continued regularly once a month. The urine has remained completely negative. For 3 months, the patient complained of an occasional

sharp pain in the bladder region especially in the scar of the cystotomy wound. This gradually disappeared. Now, 7 months after the accident, he complains of occasional pains in the perineum, more noticeable during the act of micturition. This is gradually becoming more and more infrequent in its occurrence. Following the operation, and the hospital convalescence, the patient gained 10 pounds in weight and resumed his regular occupation at the end of September, 1922, 3 months after the accident.

We thought it would be of considerable interest to obtain a direct visual picture of the mucous membrane in the region of the urethral tear. An urethroscopic examination was made by Dr. J. H. Friedman, whose findings were unusually interesting. There was nothing pathological found anywhere in the urethral canal distal to the verumontanum. There was no scar formation running in a transverse direction nor any interference with the caliber of the lumen. Just proximal to the verumontanum, and running in a longitudinal direction along the floor of the urethra was a linear slightly raised thickening of the submucus tissues. In view of the fact that the urethral rupture had occurred about 2 centimeters distal to this point, this abnormality most probably represented some anatomical anomaly. This examination was made 7 months after the inception of the injury. In the absence of any scar tissue formation at this late period, we have every reason to suppose that the anatomical end-result in this case can be marked: good.

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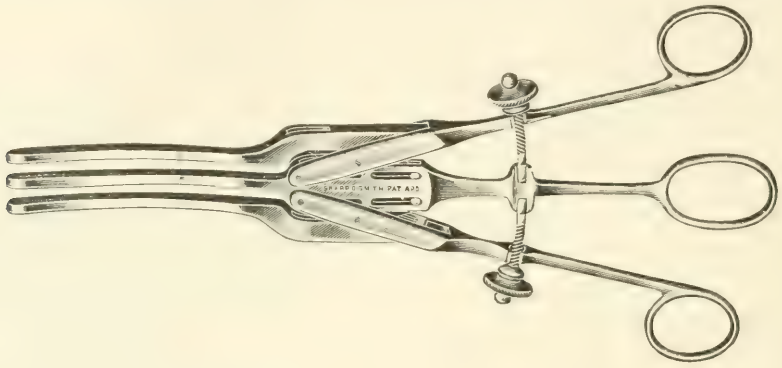
A NEW GASTRO-ENTEROSTOMY CLAMP

By C. A. ROEDER, M.D., F.A.C.S., Omaha, Nebraska

IN the technique of gastro-intestinal anastomosis, a parallel approach of the blades of the clamps used to approximate the two segments to be joined is most essential. The three bladed clamps of Linnartz and Roosevelt have simplified the technique beyond the use of the two separate forceps held together by assistants or by additional instruments. The disadvantage, however, of these three bladed, as well as all other clamps, is that unequal pressure is exerted on the stomach and intestine at the proximal and distal ends; when sufficient pressure is obtained to hold the stomach and jejunum in proper approximation at the distal end, the resulting pressure at the proximal end is too often injurious to the walls of the segments involved. A proper clamp will always be desirable in performing a gastro-enterostomy to eliminate contamination and hæmorrhage.

The clamp illustrated is designed with the idea of parallel approximation of three blades and it meets every requirement for performing a short loop gastro-enterostomy, exerting equal pressure at the proximal and distal ends. Because equal pressure is produced, only very thin rubber covering is required, and it is now necessary for the rubber to act merely as a friction surface, as a cushion is not necessary. With other styles of clamps heavy rubber tubing is required to prevent injury to the walls of the stomach and jejunum.



This clamp should be kept thoroughly oiled to prevent too much play in its mechanism and should be boiled occasionally in a weak soda bicarbonate solution to keep its mechanism clean.

CORRESPONDENCE

A CASE OF "APOPLEXIA GLANDULÆ THYREOIDEÆ"

THE case described by Green in the August, 1922, issue of SURGERY, GYNECOLOGY AND OBSTETRICS is similar to one which came under my observation and I believe is worthy of being reported. The beautiful plates that accompanied Green's article reminded me of my case which showed an analogous local discoloration of the skin on the upper part of the body.

This patient came under my notice in 1893 in Poltava, a town in southern Russia. An old German lady of 65, the wife of the late Dr. Meyer, the physician of the College for the Ladies of Noble Birth, was suddenly taken ill on her return home from the railway station, whither she had accompanied her son who was leaving her for several years. This parting caused her great grief and she sobbed violently. She sat down to dine and found to her great terror that she could swallow neither food nor drink as it refused to pass her throat.

I was called to see her 8 hours after she was taken ill and I found several physicians in consultation, all anxious to do their best for a person so highly esteemed, and all puzzled by the mysterious nature of the illness, the cause of which they were unable to explain. It was midnight, the patient could not lie down, but had to be propped up in a half-sitting position. She was paler than usual, and the lower part of the neck was somewhat swollen but not to any very great extent. She drew my attention to the fact that her collar seemed to have grown tight in so few hours and made her feel uncomfortable. She was quite conscious. The pulse and the temperature were normal, she felt no pain, but she was frightened at not being able to swallow even a drop of water. Whatever she took into her mouth, was regurgitated through her mouth or through the nose. The act of bending her head in any direction caused her great distress. Upon examining her throat I found that the two lateral tonsils and the soft palate, especially the uvula, were as white as paper and formed a strong contrast with the normal rosy color of the mucous membrane of the gums, of the tongue, and of the inside of the cheeks. Upon touching them I did not experience any sense of resistance, but, on the contrary, the mucous membrane was soft, flabby, and somewhat swollen. The only abnormal symptom to be noticed was the painfulness of the isthmus of the thyroid gland which in her case had always been double its normal size, for in the neighborhood of Poltava, owing to the marshy river Worskla, many women suffer from goiter. Mrs. Meyer had not hitherto shown evidence of this complaint. She refused to have a stomach tube or œsophageal sound introduced into her stomach. As there were so few symptoms, my colleagues and I could not agree on the diagnosis, and it was not until the next morning, when we noticed the swelling of the lower part of the neck and especially the swelling of the whole throat at the back, that it occurred to me that some obstacle must have suddenly arisen under the fascia profunda colli. Using this as my hypothesis I expressed an opinion that one of the larger arteries of the neck

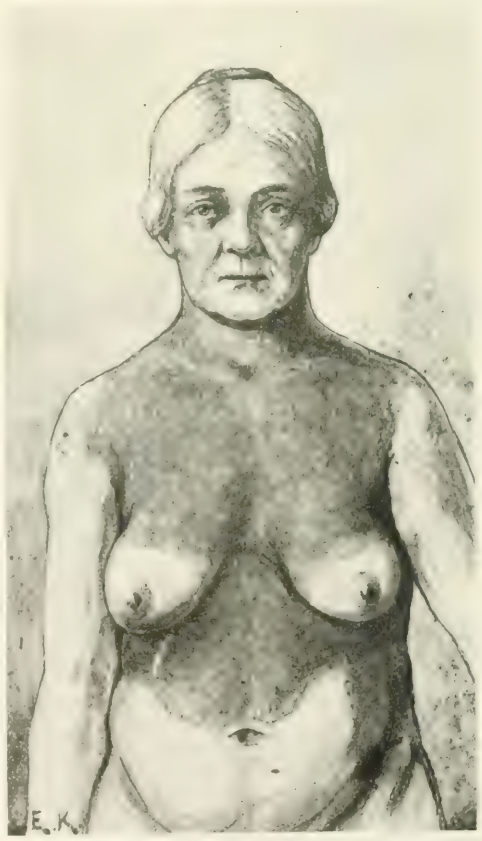


Fig. 1. Drawing showing patient on tenth day of the disease when extravasation of blood was at its height.

lying under the fascia profunda colli must have burst.

One could not observe any symptoms of sclerosis in the extremities, but the arteries of the temple were lengthened and somewhat hardened, yet one could feel the pulse, which proved that both carotid arteries were normal. It could be surmised that one of the branches of these arteries had burst. Which then? My supposition was that is was one of the four thyroid arteries and if that were so, a hæmorrhagic spot on the skin in the jugulum sterni would appear in due course. And, indeed, 50 hours after the beginning of the trouble two dark spots did appear above the jugulum sterni, on either side of the middle line of the neck. The location of those two small spots seemed to indicate the points of the exit of the two external jugular veins through the fascia to the deep jugular veins. It became clear to me then that the blood that was discharged under the deep fascia of the neck had profited by the two spaces close to the two jugular veins to show through them under the skin. I predicted then that this extravasation of blood would spread widely on the chest and on the neck. My prediction came true in a manner unique in my experience.

The accompanying diagram may give an idea of the size of the extravasation of the blood. These symptoms appeared in a few days' time in this succession: during the first 5 days the discoloration spread over the neck and the upper part of the chest and toward the tenth day extended to the line indicated on the picture.

The symptoms of dysphagia disappeared gradually soon after the appearance of the discoloration of the skin. At the same time I noticed that the mucous membrane of the throat regained its normal color. Soon the patient was well again and to my great joy I had not the opportunity of verifying my hypothesis by the means of an autopsy. I have been waiting for 30 years for a similar case, but in vain, and only the case presented by Dr. Thomas Green induced me to describe the case of Mrs. Meyer.

In my practice as a surgeon I have seen many cases after "strumectomia" where the extravasation of blood extended as far as the chest but never to such extent.

In German literature I have found only two cases somewhat analogous, one of which concerns a girl who was stabbed in the thyroid gland, but the extravasation was of somewhat smaller size. This case was described about 30 years ago in the *Deutsche Zeitschrift fuer Chirurgie* and was illustrated by a very good diagram.

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EDITORIALS

SURGERY, GYNECOLOGY AND OBSTETRICS

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OCTOBER, 1923

COLOSTOMY; A PRELIMINARY MEASURE IN RESECTION OF THE DISTAL COLON FOR MALIGNANCY

SEGMENTAL removal of the colon for malignancy in any of its divisions is a formidable manœuvre, the mortality of which is influenced not so much by its technical difficulties as by the toxæmia and dehydration which accompany obstructive lesions of the large bowel. The technical difficulties which arise are chiefly limited to the left half and are mainly due to the immobility of this segment caused by its shortened mesentery or by attachment to adjacent vital organs, or by perforation or abscess formation. The uncertainty of the distribution of the normal blood supply of the distal colon is an additional factor which renders more hazardous its attack by surgery than that of the proximal half.

The distal colon, because of the nature of its contents, as well as the increased difficulties of surgical attack, is less advantageously removed in one stage, even when no obstruction is present, than its fellow of the opposite side. Obstruction even of a very moderate degree tends to make the bowel wall œdematous and soft, and consequently increases the danger of perforation following resection and restoration of the continuity of the lumen. The bacterial flora normally present becomes most active under obstructive conditions, and in devitalized and dehydrated individuals, whose already lowered resistance is severely taxed, any infection even of a low grade is liable to result fatally.

Stiles is inclined to advocate preliminary colonic drainage in all cases of carcinoma of the colon beyond the hepatic flexure and is one of the stanchest advocates of a graded operation. Cæcostomy as performed by him in all these cases is a procedure well worthy of consideration and acceptance. Cancer obstruction generally is subacute for a considerable time before it completely occludes the bowel lumen and, with the possible exception of hæmorrhage, is the most frequent cause of medical advice being sought.

Unhappy experience has taught the dangers and high mortality of an attempt at a complete resection in the face of total obstruction and the inclination, at present, to consider obstruction of any degree a contraindication to radical operation is gaining vogue. The anæmia which is an almost constant accompaniment of colonic carcinoma and which so frequently is seen to occur without loss of blood, is a primary reason for placing these cases of any length of standing in the category of grave surgical risks. Dehydration and toxæmia which accompany the absorption of the poisonous products of the obstructed bowel add to the risk of operation so materially that in many cases the pre-

operative preparation demands that they be combatted by transfusion of blood and by forcing the fluid intake.

Several years ago W. J. Mayo pointed out that the attempts to increase the limits of operability in malignant disease of the colon resulted in a rapid and marked increase in the mortality percentage because of the acceptance for surgical intervention of bad risks, which had hitherto been excluded. That this was justified was made plain where it was shown that out of each 100 cases operated upon, more patients were alive at the end of a given number of years than in the other group which attacked only movable growths without demonstrable metastasis. Operative procedures which are feasible must not only offer the patient a reasonable chance for ultimate cure or at least a prolonged palliation, but they must do so with a reasonable death rate. Radical attempts at extirpation at a single stage by any of the recognized technical methods of resection and end-to-end anastomosis, or over a tube, or by the combined abdomino-perineal route can in many instances be replaced by a graded operation without sacrifice of thoroughness and with a lower mortality because the local and general condition of the patient has improved.

Operations of the Mikulicz-Burns type are safe and in the main satisfactory. Because this operation does not contemplate the opening of the bowel lumen until the peritoneal cavity has been sealed off by adhesions, it is attended with an extremely low mortality, and it is applicable to most growths at the rectosigmoid junction as well as in the sigmoid and descending colon. At the end of 48 hours, if obstruction is marked, it is possible safely to excise the tumor mass which has been brought out on the abdominal wall, thus converting the operation into a delayed colostomy. One criticism leveled at this operation is the prolonged convalescence which is necessary and, in addition, that there is a definite percentage of recurrences in the abdominal wall.

Rarely can one promise the patient that the convalescence following this type of operation will be completed within less than 3 months. Generally attempts to hasten the closure result unfortunately, the infected and thickened wound edges being slow of union and refusing to heal with any degree of promptness.

A colostomy, cæcostomy, or ileostomy followed within a short time by radical removal of the malignant segment offers perhaps as high a percentage of cures and as reasonable mortality as any of the manœuvres now being practiced. The advantage of this method is twofold: first, it permits of exploration; second, the immediate relief of obstruction by reduction of toxæmia permits a second extensive operation upon a patient whose resistance has been increased by the drainage and supportive measures subsequent to it, and therefore is a less hazardous risk. The second stage of operation may be as radical as the choice of the operator dictates. There is no increased difficulty in performing the resection because of the presence of the colostomy, and the chances of union at the site of anastomosis are markedly increased. With the colostomy above the anastomosed bowel, the hardened fæces are diverted from passing over the suture line and its ultimate healing is insured. The difference in blood supply, in different individuals and in different segments of the colon makes primary union following resection of the left half uncertain enough to necessitate abdominal drainage in all cases from fear of leakage. With the bowel cut off above the suture line by colostomy, the inactive lower segment rarely fails to heal readily, even though in a small

number of cases pelvic abscesses have been found to form. The two types of operative procedure which have been found especially advantageous as preliminary colostomy are: first, a modification of the Mixter method; and, second, the Maydl-Littlewood type. The left rectus colostomy is entirely satisfactory either as a temporary or permanent procedure, but it should be remembered that occasionally a loop of small bowel slips to the outer side of the proximal colon and becomes obstructed. This is obviated by making the colostomy well out in the groin and by placing a few interrupted sutures between the outer leaf of the colonic mesentery and the parietal peritoneum, thus closing any opening through which any small bowel can herniate. The colostomy may be opened any time after 48 hours but it is well to allow patients to go for at least 7 or 8 days if the gas distention is not too troublesome.

Colonic irrigation of both segments distal and proximal to the colostomy is advisable to cleanse the lower segment for subsequent operation and to reduce the toxæmia already present by emptying the contents of the proximal division. In making the second stage resection, it is advisable to approach the growth through a mid-line incision. Attempts to do the operation through an incision to the outer side of the colostomy will be found to be more difficult.

Whatever the operative procedure finally determined upon, a most vigorous attempt to increase the vitality of the individual should be undertaken by strenuous pre-operative attention to overcoming the devitalization, incident upon the toxæmia, anæmia, and dehydration, which the majority of these patients present.

With this in mind it seems feasible that a graded operation which permits of exploration and a later resection without sacrifice of thoroughness, but with a lower mortality, should warrant more extended usage.

FRED RANKIN.

EXPLORATORY INCISION VERSUS PARACENTESIS IN ASCITES

IN practically all cases of ascites it is a simple matter to obtain the patient's permission to remove the accumulation of abdominal fluid by tapping, but consent to perform an exploratory laparotomy under local or gas anæsthesia may be more difficult to obtain unless some distinct advantage of the procedure can be explained to the sufferer. In reviewing some old case histories, I have been impressed with the large amount of knowledge gained and the very small harm done by a 3 inch incision under local anæsthesia, and, where indicated, the performance of an omentopexy as suggested by Narath.

Palpation is undoubtedly a very satisfactory aid to diagnosis, and organs or tumors can certainly be more successfully palpated if the abdominal fluid is withdrawn. Granting this, it is logical to assume that the investigation will be even more successful if, after the fluid is withdrawn, palpation and inspection are resorted to through an abdominal incision. Cytological examination of the fluid withdrawn by tapping may demonstrate carcinoma or tuberculosis, especially the latter after guinea-pig inoculation, but when exploration is done through an abdominal incision, tissue may be removed for histological examination, and the diagnosis will be correspondingly more exact.

There are those who argue against the procedure on the ground that it causes surgical shock or trauma, and who classify it as another "unnecessary operation." No operation that establishes a diagnosis and indicates

treatment can be called unnecessary, and in the hands of a competent surgeon the procedure is devoid of any serious risk. In a rather large experience, the writer has never seen any untoward effects. Naturally anatomical knowledge, skilled technique, and careful asepsis are taken for granted, and in addition it must be emphasized that it is wise not to allow any of the intestinal mass to escape onto the abdominal wall. The distended coils are difficult to replace, and the extra manipulations necessary may cause nausea and vomiting, thereby increasing the difficulty of the operation under local anæsthesia. Again, adhesions may be torn, causing annoying hæmorrhage, and the diseased bowel, which is often very friable, may even be torn. Every factor for the patient's safety must be taken into consideration if this procedure is to give us the results we desire, and the observance of this point in technique will save embarrassment and add to the patient's comfort, and to the ease of his recovery.

On the other hand, there are some dangers to be mentioned in connection with paracentesis. While such accidents as hæmorrhage from injury to a blood vessel or puncture of the bladder are infrequent, they must be borne in mind and guarded against. Tapping an ovarian cyst or similar growth complicates its subsequent removal, and may be fraught with immediate danger. We must remember, also, that in many instances tapping is merely a temporary measure of relief, that it often leaves us no wiser than we were before as to the condition to be dealt with, and that valuable time may be lost, and even the chances of a cure through operation thrown away while this procedure is being tried and ultimately discarded.

As Dock[1] in his classical paper notes, the exploratory incision reveals not only the presence of cancer or other pathology, but the extent of the disease and the possible measures of relief. All operators are familiar with cases in which the first manifestation of trouble to which the patient attached any importance was ascites. Very often it is the first symptom of malignant disease, and it is a frequent symptom in curable pelvic conditions. In a recent instance I advocated an exploratory incision in a patient who had been tapped without result other than the purely temporary relief consequent upon the withdrawal of the fluid. The condition was thought to be a simple cirrhosis of the liver, and only when tapping and free catharsis failed to relieve was the exploration permitted and the true condition learned. At operation I found a large pelvic neoplasm, with liver metastases, for which, of course, nothing could be done. An earlier exploration might have given a very different result. Dock illustrates his argument by citing several cases where curable pelvic conditions were found at operation, when several previous tappings had been done with no permanent benefit. His list includes one dermoid cyst of the ovary, one fibroid tumor of the uterus, and several cases of tuberculous peritonitis, cancer of the stomach, etc. To these I would add several cases of tuberculous peritonitis in my own practice, one non-parasitic cyst of the liver, and one echinococcus cyst.

We must admit that paracentesis has a field of usefulness in certain inoperable conditions, and, to some extent, as a diagnostic aid, but its field is limited, and I would make a plea for more frequent exploration through a suitable incision under local or light general anæsthesia. This can be done without risk to the patient, and frequently with distinct benefit.

Ascites is a convenient term in general use, and may cover a wide variety of con-

[1] Internat. Clin., S. 2, ii.

ditions. Some of them may be curable and pass unnoticed until too late, others may be already inoperable, and most of them are likely to be difficult or even impossible of recognition merely by history and physical examination, however careful and painstaking. In all such cases the underlying pathology will be rendered less obscure and the patient's chances of complete or partial relief materially improved if exploratory laparotomy is substituted for simple paracentesis.

URBAN MAES.

GENERAL GORGAS

A SERIOUS movement is under way to honor the great soldier-doctor, William Crawford Gorgas. If you are interested in this project you are invited to read the brief biographical sketch on pages 546 to 558 of this issue, and to peruse advertising page 45, on which appears the summary of a plan that has been formulated to provide a working institute that will honor the memory of General Gorgas in the manner that would have pleased him. F. H. M.

MASTER SURGEONS OF AMERICA

WILLIAM CRAWFORD GORGAS

MAJOR GENERAL WILLIAM CRAWFORD GORGAS was an international character and his professional career, medical and military, included accomplishments of supreme importance, involving responsibilities that brought to him enduring fame.

In this brief sketch of his life, it is the purpose to bring out only a few of the salient points of his remarkable career which will serve to illustrate his character, and particularly to bring to light a few unknown facts about his labors as Surgeon General of the United States Army during the World War.

I. BIOGRAPHY

William Crawford Gorgas was born in Mobile, Alabama, on October 3, 1854. He was the son of General Josiah Gorgas, the chief of ordnance of the Southern Confederacy during the Civil War, and later the president of the University of the South, at Sewanee, Tennessee. Gorgas was graduated from the University of the South with the degree of A.B. in 1875, and from Bellevue Hospital Medical College with the degree of M.D. in 1879. He entered the Medical Department of the United States Army on June 16, 1880, as first lieutenant, was advanced to captain in 1885, and to major in 1898.

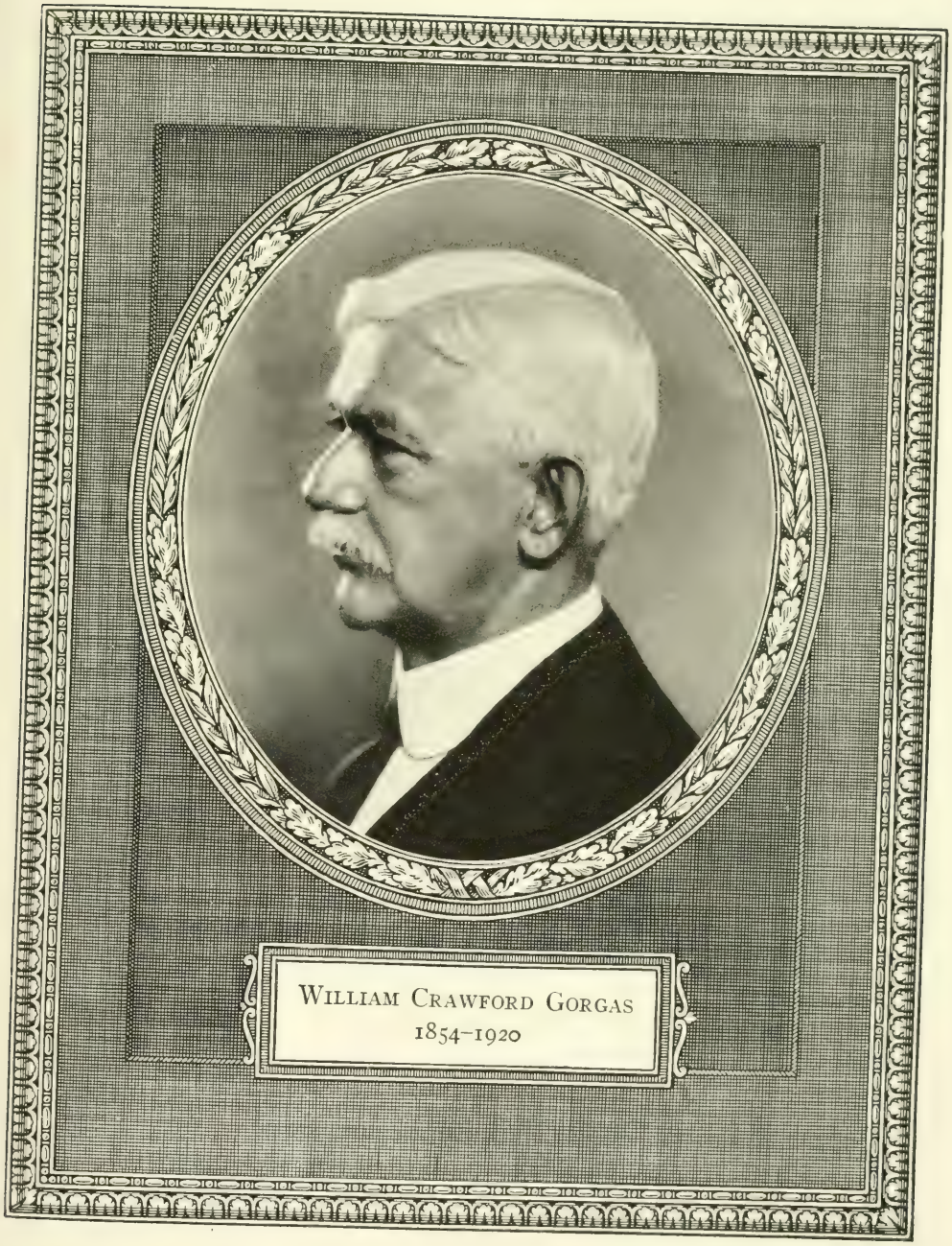
In 1880, yellow fever was prevalent in Brownsville, Texas, in violent epidemic form. Conditions were bad beyond the power of words to portray to those who have no recollection of conditions in a yellow fever stricken city prior to 1880. The government as well as the people at large had been appealed to.

General Gorgas, with the rank of lieutenant, was sent to Fort Brown, near Brownsville, to assist in the medical care of the civilian population. There he first met Miss Doughty, later Mrs. Gorgas, who then was seriously ill of yellow fever, and there he contracted the disease also.

Later, Gorgas was in active service in Florida, in the West, in Dakota, and in the old Indian Territory.

He accompanied the military expedition against Santiago in 1898. Fate, possibly with a purpose, visited his system with yellow fever in early life, thereby making him immune to the disease. Because of his practical knowledge of yellow fever, he was appointed chief sanitary officer of Havana, which post he occupied from 1898 to 1902.

It was in 1900 that Gorgas was in close contact with the investigation that was being conducted in Havana by the Walter Reed Board, the purpose of which was to determine the course of yellow fever. The memorable discovery



William Crawford Gorgas
1854–1920

made by this board revealed the cause thereof; but it was Gorgas who applied these principles and effected the eradication of yellow fever from Havana.

In 1904, Gorgas was appointed chief sanitary officer of the Panama Canal Zone, and in 1907 he was made a member of the Isthmian Canal Commission. In recognition of his work in Havana, his rank was increased to that of colonel by a special act of Congress in 1903, and he became assistant surgeon general of the United States Army. In 1915, Gorgas and his associates on the Isthmian Canal Commission received a vote of thanks from Congress for distinguished service rendered in connection with the construction of the Panama Canal.

In 1913, General Gorgas went to Rhodesia, South Africa, at the invitation of the Chamber of Mines, Johannesburg, to advise as to the best means of preventing pneumonia and malaria among the native mine workers. He was appointed surgeon general of the United States Army, with the rank of brigadier general, on January 16, 1914, and was given the rank of major general in 1915. He served with great distinction as surgeon general during the trying period of our participation in the World War, until his retirement on account of age on October 4, 1918.

He never lost his interest in world sanitation. While he was stationed in the Canal Zone, he visited Guayaquil, Ecuador, and mapped out a plan for the control of yellow fever in that disease-ridden district. In 1916 he was made chief of the special Yellow Fever Commission of the Rockefeller Foundation, and spent several months in South America making surveys and laying plans for the eradication of yellow fever from localities in which it still prevailed.

After his retirement as surgeon general, he immediately accepted the assignment to direct the yellow fever work which had been undertaken by the International Health Board of the Rockefeller Foundation. On May 7, 1920, he sailed for England, en route to West Africa, where he was to investigate the yellow fever situation. He fell ill in London on May 30, 1920, and died on July 4, 1920.

II. CHIEF SANITARY OFFICER OF HAVANA

1. Preliminary Investigation of Course of Yellow Fever

Many names have become historical in connection with the preliminary work which was pursued to demonstrate the course and means of transmission of yellow fever. Dr. Walter Reed, who was at the head of the sanitary board that finally succeeded in working out in detail and demonstrating the course of this disease, said of one of these early workers: "To Dr. Carlos Finlay, of Havana, must be given, however, full credit for the theory of the propagation of yellow fever by means of the mosquito, which he proposed in a paper before the Royal Academy in that city at its session on the 14th day of August, 1881."

It was not until 1899 that the then Surgeon General Sternberg, of the United States Army, who was one of the leading bacteriologists of the profession and also one of the leading known authorities on yellow fever, induced the secretary

of war to appoint a board of army medical officers to investigate the entire subject of yellow fever. This board consisted of Doctors Reed, Lazear, Carroll, and Agramonte, and proceeded with its investigations in Havana, where General Gorgas was stationed at the time as chief sanitary officer. Necessarily, Gorgas had much contact with this board and with its individual members. The Sanitary Department of Havana had a commission of medical men to whom all cases of yellow fever were referred for diagnosis. This commission was comprised of General Gorgas, Dr. Carlos Finlay, Dr. Antonio Albertini, and Dr. Juan Guiteras, and co-operated closely with the Walter Reed Board. This board, of which General Gorgas speaks as "this now famous and immortal board," completed its comprehensive investigations and presented its findings or conclusions early in 1901.

2. *Findings of Walter Reed Board*

Gorgas looked upon the discovery of the Walter Reed Board with the eye of an appraiser. He had watched the process of its development, and by his knowledge of the subject, he judged of its value and was convinced that the experiments of the board left no doubt of the reliability of its claims.

Yellow fever was caused by a germ that was transmitted to men by the bite of a female stegomyia mosquito. This mosquito must first bite a yellow fever patient after the third day of the onset of the disease. Within the period of from twelve to twenty days after biting the yellow fever patient, the mosquito was able to transmit the disease to a non-immune individual. This was the theory furnished by the scientists, which Gorgas pondered over and which made him realize that to him had come the opportunity to utilize it in controlling or eradicating yellow fever.

3. *Eradication of Yellow Fever*

With these facts before him, he plainly saw that yellow fever could be eradicated if no yellow fever victims were bitten by a stegomyia mosquito after the third day of the disease. It was likewise obvious that yellow fever could not develop if a female stegomyia mosquito that had bitten a yellow fever patient did not bite a non-immune individual within the period of from twelve to twenty days afterward. Therefore, if a patient having yellow fever were isolated to the extent that no mosquito could bite him, there could be no transmission of the disease from that patient.

His direct working mind had this material as a basis. He foresaw that he must eliminate all traditional, irrelevant notions about the development of yellow fever, and concentrate on this new theory that he was convinced was true. First, then, he must, so far as possible, destroy the stegomyia mosquito; second, he must screen all victims of yellow fever so as to prevent them from being bitten by mosquitoes that would transmit the disease; and, third, he must screen all non-immune individuals against the bite of the stegomyia mosquito. How simple!

But he had the traditions of ages to combat, and he had to deal with thousands of people of a great city, few of whom knew anything of science, and to whom it would be difficult to explain his problem. Then, too, there was the medical profession itself, which is too often too slow in adopting new theories which are established by scientists. He had to re-educate society and change its attitude toward the control of disease, supplanting the traditional teachings of years, that the disease was caused by filth, miasma, night air, and contagion through personal contact, with the new theory of mosquito propagation. He had before him the problem of discovering a method of destroying the mosquito where every condition existed which was most favorable to its development. He had to supervise the care of sick individuals who must be served by trained assistants who believed in and understood the work in which they were engaged. Those people whose houses had to be ridded of mosquitoes had, necessarily, to be put to great inconvenience and expense. A government had to be convinced that past methods, in the pursuit of which it had spent vast sums of money, were all wrong, and that it must appropriate sufficient funds to make possible a trial of the new theory.

But his enthusiasm, his staunch belief in his proposed methods, his immediate initiative, and his great industry overcame all obstacles, and between the time of the announcement of the plan on February 1, 1901, and September 15, 1901, a period of less than eight months, he eradicated yellow fever from Havana, where it had continuously existed for over 150 years.

4. Malaria Control

The plan followed to rid Havana of yellow fever, with its resultant destruction of the stegomyia mosquito, also destroyed the anopheline mosquitoes which propagate malaria. The result of this work was to reduce malaria in a most marked degree. Before 1901, Havana, dating back to 1872, had an average yearly death rate from this disease of over 300; in 1898 it rose to 1,900. Since 1901, after the systematic destruction of mosquitoes inaugurated by Gorgas, malaria steadily decreased until in 1912 there were only four deaths. This means practically the extinction of malaria in Havana, as these four deaths could be attributed to patients brought from infected districts outside of the city.

General Gorgas at all times was the most modest of men, and never for one moment did he fail to minimize his own work in comparison with that of his contemporaries or predecessors. This is shown in the following paragraph in which he summarized the accomplishment in Havana:

"There has been a great deal of discussion as to who deserves the credit for this great discovery. Undoubtedly Reed and his board brought all the threads together and actually made the great discovery; but Finlay, Sternberg, Carter, and others started the spinning of many of these threads. Like all great discoveries everywhere, it was gradually led up to by many workers."[1]

[1] Sanitation in Panama.

III. CHIEF SANITARY OFFICER OF PANAMA

1. Yellow Fever Eradication

Although it was urged that a medical man should be made a member of the Isthmian Canal Commission, as sanitation at Panama, as demonstrated by the experience of the French, was fully as important as engineering, the commission, under the Spooner Act, consisted of seven members, five of whom were engineers, and no physicians.

During the latter part of March, 1904, General Gorgas, with three associates appointed at his request — namely John W. Ross, U. S. N., Major Louis A. LeGarde, surgeon, U. S. A., and Major Cassius E. Gillette, Corps of Engineers, U. S. A.—was ordered to accompany the Panama Commission as its sanitary advisor for the purpose of drawing up a scheme of sanitation whereby the force might be protected during the construction of the Canal. "After much study and careful consideration," he said, "we submitted a report which embodied the organization which we thought necessary to accomplish the desired ends. The report gave detailed estimate of the cost of this organization."[1]

In April, 1904, General Gorgas was ordered to report to the commission as the chief sanitary officer for the Isthmus. He was authorized to employ a certain number of men for the preliminary work, and given an appropriation of $50,000. On May 4, the French company formally transferred the Canal property to the United States, and early in June the work began.

Lack of proper organization was one of the difficulties which had to be met with at the beginning. The supply departments in the United States were slow in furnishing supplies, and few requisitions were filled. This was due to the attempt of the first commission to manage from Washington. Gorgas, however, had taken the precaution to bring with him his $50,000 worth of supplies and his picked personnel, which enabled him to start without undue embarrassment, in direct contrast to the showing of the Engineering Department or the Quartermaster's Department for the same period.

From the careful study made by Gorgas, he realized that the subject of yellow fever was by far the most important phase of sanitation with which he had to deal. The enormous death rate from this disease that the French had suffered would make it very difficult for the United States to supply officials and laborers for the digging of the Canal. The cost for labor would become prohibitive, and the appalling death rate would make Congress hesitate to take the responsibility of continuing the work. The best statistics available showed that the French lost yearly by death from yellow fever about one-third of their entire force. At this rate, with the number of men employed, the United States would lose by death from this dread disease about thirty-five hundred men yearly.

The sanitary problem in Panama was many times greater than that in Havana; the commission in control of the construction of the Canal was located

[1] Sanitation in Panama.

in Washington, and the sole point of contact with this supreme authority was through the then resident governor of the Canal Zone, General George Davis. The commission as a whole at the beginning was prone to underestimate the magnitude of the sanitary problems as well as the cost, and was inclined to look upon the extensive plans of General Gorgas as visionary.

However, Gorgas, with his entire force and financial resources, began his work in an effort to destroy the yellow fever mosquito; to repeat, but with greater intensity, the work that had been so effective in Havana.

One problem that was not present in Havana but that had to be met with in Panama was the care of the enormous influx of unacclimated and non-immune whites who were being brought in as officials and employes of the commission.

"Our force," says Gorgas, "of unacclimated whites liable to yellow fever rapidly increased during the winter of 1904 and the spring of 1905. Yellow fever increased with still greater rapidity. The authorities became more and more alarmed. In January, 1905, the first commission was asked to resign. . . .

"Even after this change, the sanitary department was in no better condition than it had been under the old commission. The chief sanitary officer was still subordinate to the governor of the Canal, and had no means of access to the chairman except through the governor. Such sanitary measures were carried through, the importance of which the chief sanitary officer could impress upon the governor. Those the importance of which the governor could not see, were with great difficulty carried into effect."[1]

This condition of affairs must have been most harrowing to the sanitary authorities who had no doubt of the ultimate success of their plan, based on their experience in Havana, if they were only allowed, unhampered, to carry out their program. The full support of the commission was difficult to obtain.

Conditions with regard to yellow fever, because of the difficulties of carrying out every detail of their plan, "kept going from bad to worse," says Gorgas, "during the first six months of 1905. In April, 1905, several of the higher officials died of yellow fever. This caused widespread panic among the whites, and very great demoralization to the work itself."[1]

In June, 1905, two members of the executive committee of the commission united in a recommendation to the secretary of war that the chief sanitary officer and Dr. Carter, and those who believed with them in the mosquito theory, should be relieved, and men with more practical views appointed in their stead.

Here is where Gorgas demonstrated that he had the courage of his convictions. It would have been an easy matter, and a course sanctioned by general usage in political affairs, for General Gorgas, in these months of obstruction through the ignorance of superior officials, to have compromised and resorted to make-shifts to curry favor with his superior in rank. By these means he might have gained temporary advantage. But Gorgas was too honest to pursue such a course, and it would have been incompatible with his direct way of doing things.

[1] Sanitation in Panama.

"Fortunately, the then President of the United States had been in office when the work at Havana had been done by us," says Gorgas. "He told the commission that the mosquito theory had been established beyond peradventure; that its application had been entirely successful at Havana where yellow fever had been more firmly established and established for a longer time than in Panama. He declined to sanction the change recommended, and directed that every possible support and assistance be extended to the sanitary officials."[1]

About this time Mr. John F. Stevens was appointed chief engineer of the commission and he recommended that the sanitary department should be made an independent bureau and report directly to himself. This enabled the chief sanitary officer, General Gorgas, to make known his needs directly to the highest authority, and there he was accorded loyal support.

"This," remarks Gorgas, "was the high-water mark of sanitary efficiency on the Isthmus, and more sanitation was done at this time than during any other period of the construction of the Canal."[1] With full authority granted to Gorgas and his aids, a repetition of the remarkable accomplishments in Havana came to Panama.

"In looking back over our ten years of work . . . ," says Gorgas, in a burst of justifiable exuberance, "1905 and 1906 seem the halcyon days for the sanitary department. . . . By the fall of 1907, about all of our sanitary work had been completed. Our fight against disease in Panama had been won, and from that time on our attention was given to holding what had been accomplished."[1]

"*One more case of yellow fever occurred in Colon during May; but since May, 1906, now more than eight years, not a case of yellow fever has originated on the Isthmus.*"[1]

2. *Malaria Control*

After the fall of 1905, when yellow fever had been conquered, attention was given to the elimination of the anopheline mosquito, which is the means of transmission of malaria. The following is the result of the campaign against malaria: In 1906, 821 of every thousand patients admitted to the Canal Zone hospitals had malaria. In 1907, this number in each one thousand was reduced to 426 malaria cases; in 1907, to 282; in 1909, to 215; in 1910, to 187; in 1911, to 184; in 1912, to 110; and in 1913, to the small number of 76.

Inasmuch as a victim of malaria seldom dies of the malady, but he is capable of supplying its germ to any female anopheline mosquito within three years of first infection, the abolition of malaria was practically impossible with seventy-five per cent of the population of the Canal Zone carrying the germs of the disease in their systems.

3. *Bubonic Plague*

In 1905, a case of bubonic plague appeared in Panama. As this disease is transferred from the rat to the human being by the rat flea, a systematic campaign to rid the Canal Zone of rats was instituted and successfully carried out.

[1] Sanitation in Panama.

4. Results of Sanitation in Panama

In summing up the results of sanitation in Panama, General Gorgas says:

"We have no means of telling what was the sick rate with the French . . . but we know it was very large. [According to General Gorgas' figures, a conservative estimate of the French rate of sickness throughout their operations would be 333 per thousand, or one-third of their force.] Our force during the ten years of construction averaged 39,000 men. If we had had a similar constant sick rate, we should have had 13,000 sick employes in our hospitals every day during the ten years of construction. As it was, we had only 23 per thousand sick each day, a total of 900 for the whole force; that is, we had about 12,000 fewer men sick every day than had the French. . . .

"*We had an average of 900 men sick every day. For the year this would give us 328,500 days of sickness, and for the ten years, 3,285,000 days of sickness. If our rate had been 300 per thousand, a very moderate figure compared with what it was under the French, we should have had 11,700 sick every day, and for the year 4,270,500, and for the ten years, 42,705,000, or an increase of 39,420,000 days of sickness for the whole period.* . . .

"*It cost about one dollar a day to care for a sick man on the Isthmus. The commission cared for the sick free of charge. Every day, therefore, of sickness prevented on the Isthmus lessened the expense which the commission had to bear by one dollar. The commission was therefore saved by this sanitary work, for ten years, $39,420,000.* . . .

"*During the ten years of construction, we lost by death 17 out of every thousand of our employes each year. That is, from the whole force of 39,000 men, 663 died each year, and for the whole construction period we lost 6,630 men. If sanitary conditions had remained as they had been previous to 1904, and we had lost as did the French, two hundred of our employes out of each thousand on the work, we should have lost 7,800 men each year, and 78,000 during the whole construction period.*"[1] *Thus the Gorgas' sanitary program saved the difference between the 78,000 estimate of deaths under the old régime, and the actual 6,630 deaths under the new, or a total of 71,370.*

5. Economic Value of Sanitation in Panama

General Gorgas estimates that the saving to the United States government due to the work of sanitation was a total of $80,000,000, taking into consideration the loss that would have occurred on account of poor morale, and the excessive wages that would have been demanded under less favorable health conditions, in addition to the hospital days saved.

Then, too, one must take into consideration the fact that our great force of men in Panama, because of the sanitary arrangements, was privileged to live in a tropical paradise, where the health conditions were as safe as in any habitable place on earth. "The Canal Zone," says General Gorgas, "for the past four hundred years, ever since it has been known to white man, has been one of the

[1] Sanitation in Panama.

most unhealthy spots in all the tropical world. And now it is one of the garden spots of our civilized world, with a health condition excelled by no land."[1]

IV. GORGAS, THE SOLDIER

1. Reorganization of Medical Corps and Medical Reserve Corps of the U. S. Army in 1916

Gorgas, the sanitarian, had reached the acme of his fame; and at the honorable age of sixty-three, as surgeon general, he was at the head of the peace-time Medical Corps of the United States Army. In 1916, although the President of the United States and a large majority of her people were definitely opposed to entering the European struggle, it was apparent that our country would be drawn into the greatest war of history. Therefore, General Gorgas, while hoping for an early peace, began to urge the reorganization of his corps.

During the spring and summer of 1916 he appeared almost daily before the Military Affairs committees of the Senate and House, and personally advised the legislators in their preparation of the army bill. It was during this time that the courtesies of the floor of the Senate Chamber were extended to him as the authorized head of the Medical Corps of the United States Army.

In the spring of the same year he was anxious to expand the Medical Reserve Corps, and as he desired to secure the best men obtainable, he consulted those who were in authority in the leading medical organizations of the country and asked them to aid him in making his selections. There could have been no safer way, and the results immediately justified his judgment. Throughout the war it was his policy to utilize every available means to add to the number and efficiency of his corps. He repeatedly said: "I want all the help I can get."

General Gorgas was quick to recognize the importance of the specialist in the organization of his corps, as it enabled each man to fill the particular place for which he had been trained and in which he could render the highest service.

2. Increased Rank for Medical Officers

It became apparent early in 1917, shortly after our country entered the war, that a provision should be instituted that would make it possible for our Medical Reserve Officers to receive rank higher than that of major. General Gorgas was always very much interested in all subjects that had to do with medical matters, and he was keenly alive to the necessity for this increased rank; and he never failed to use his influence and initiative to make his desires known. He realized that this was a war that would require the services of the very best of the medical profession, and to its organization would be attracted our most eminent and influential practitioners of medicine, surgery, and dentistry. The armies of Europe, including our allies, England, France, and Italy, during three years of actual warfare, had seen the necessity in the organization of their respective medical reserve corps of giving advanced rank to their medical

[1] Sanitation in Panama.

officers, many of whom were then serving as lieutenant colonels, colonels, brigadier generals, and even major generals. In our overseas armies, our medical officers would soon be associated with these medical officers of European nations. Immediately they would find themselves at a distinct disadvantage in their association with them, and they would be subjected to humiliation because of their lower rank, although they would be performing the same duties and assuming the same responsibilities.

The executive committee of the Council of National Defense presented the subject to Secretary of War Baker, and through him the committee was invited to present its case to the War College. General Gorgas, Dr. Charles H. Mayo, Dr. William H. Welch, Dr. Victor C. Vaughan, and the writer made up the committee on the occasion of its first appearance before the War College. A strong argument was presented by General Gorgas in favor of increased rank for medical officers, and a general discussion followed in which all members of the committee who were present participated, as well as the group of officers representing the War College. While our requests were not definitely turned down in these early discussions, it soon became apparent to us that no move was being made to change the law or regulations, and finally we were convinced that the initiative along this line would have to come from us.

Senator Owen was selected to look after our interests in the Senate, and we co-operated with him in formulating a bill. Because of the lack of enthusiasm in our behalf on the part of the secretary of war and the general staff, the whole subject was presented to President Wilson, with a plea for his support. To the great satisfaction of the executive committee of the General Medical Board, the following reply was received from the President:

March 5, 1918

My dear Doctor Martin:

I read very carefully your memorandum of February twenty-seventh about the rank accorded members of the Medical Corps of the Army and have taken pleasure in writing letters to the chairmen of the Military Committees of the House and Senate, expressing the hope that the bill and resolution may be passed.

Cordially and sincerely yours,
(Signed) Woodrow Wilson.

Dr. Franklin Martin
Advisory Commission
Council of National Defense
Washington, D. C.

With the introduction of Senator Owen's bill, a prolonged series of hearings on the subject were held before the Senate Committee on Military Affairs. Later a bill was introduced in the House by Representative Dyer, which modified in some unessential details the Senate bill. This brought the matter before the Committee on Military Affairs of the House. After many hearings in these committees, almost all of which were attended by General Gorgas and the writer, and at various times other members of the executive committee, including Dr. William J. Mayo, Dr. Victor C. Vaughan, Dr. Charles H. Mayo, Dr. William H. Welch, Dr. Frank F. Simpson, and others, it was deemed wise to combine the

Senate and House bills into one uniform bill. This resulted in a meeting in my office as the medical representative of the Advisory Commission of the Council of National Defense, where the Owen-Dyer bill was formulated. General Gorgas, Senator Owen, Representative Dyer, and Brigadier General (then Colonel) Noble and the writer were present at this meeting. General Gorgas practically dictated the changes that were agreed upon, and the bill was written. The following day the Owen-Dyer bill was presented simultaneously in both houses of Congress, in the Senate by Senator Owen, and in the House by Representative Dyer. After many vicissitudes and alterations, it was attached as a rider to the general appropriations bill.

Before the Owen-Dyer bill was dignified by becoming a rider to the general appropriations bill, a serious propaganda for and against the bill was waged for a considerable period of time. Many hearings were held before the Military Affairs committees, and General Gorgas was at the forefront in his advocacy of our bill. Members of the different medical societies were requested to exert their influence with their Senators and Representatives, urging them, by resolutions and by personal letters, to pass the Owen-Dyer bill. During this time of intense opposition, General Gorgas and I were called before Assistant Secretary of War Crowell and Chief of Staff March for pernicious activity in behalf of the Owen-Dyer bill. The assistant secretary proceeded to quiz Surgeon General Gorgas regarding his activities in advocating legislation concerned with the corps, the uniform of which he wore and of which he was the head. It was even intimated that he had in public addresses urged men to write to their Congressmen and Senators, instructing them to vote in a certain way. When General Gorgas was asked directly if he had committed these indiscretions, he answered that he could not remember that he had been guilty of the particular act of which he was accused. "But," he said, in his direct and outspoken manner, "you know, Mr. Secretary, I am in favor of the passage of the Owen-Dyer bill, and I would consider myself disloyal to my corps if I did not do everything in my power to bring about its passage."

The assistant secretary was disarmed by this frank statement, and evidently forgetting to make the point that it was contrary to regulations for an officer to interest himself in legislation, he began to argue the merits of the bill for increased rank. He asked General Gorgas if he was not inconsistent in urging higher rank for members of his reserve corps when there were other reserve corps for which such increased rank would be equally desirable. "Not at all," the General replied. "I have no definite knowledge of the requirements of the other corps, and I should never think of interfering in their organization. I do, however, know the needs of my own corps, and I feel that I must favor such a change in the law as will meet them."

General Gorgas was then asked to explain just how the passage of this law would benefit his corps. In his quiet, convincing manner he responded by drawing a mental picture of his vast corps, with its service in the camps of this

country; its service overseas where the distinguished members of our medical profession, serving as majors, were working side by side with their distinguished confrères of Europe who, while performing the same duties, were colonels, brigadier generals, and major generals, thus outranking our own men and bringing many unnecessary humiliations to bear upon them. The story was so convincing, so unanswerable, and so pleadingly told (the names of well-known civilian doctors serving as illustrations), that the General, obviously, had won his case.

Finally, the general appropriations bill, of which the Owen-Dyer bill had become a rider, was passed by the House and the Senate, and was in the hands of the conference committee, appointed by the two Houses of Congress, for agreement. The conference committee was to report that day, and at a given hour in the afternoon the completed bill was to be ratified by both Houses.

At this time (Secretary of War Baker having returned from overseas) a desperate, vicious attack was inaugurated against the bill by the subtle propagandists. A conference between the secretary of war and Senator Owen much disturbed the Senator, who was one of the authors of the bill. It appeared that there was much opposition, especially to the creating of the higher ranks of brigadier general and major general. The argument was urged that if the opposition of the secretary of war, and of the War College, represented by the chief of staff, should induce the President to veto the bill because of this rider, the whole general appropriations bill would fail of passage. An appeal to the patriotism of those supporting the Owen-Dyer bill, asking them to abandon the essential features thereof, was adopted as a ruse of the opposition in an effort to gain its point.

At nine o'clock in the morning, after an interview with Senator Owen and a conference with the official advisors of his own department, General Gorgas came to the writer's office, much depressed. The conference committee was to report early in the afternoon and the two branches of Congress were to take a final vote on the ratification of the bill. They had urged that he should consent to abandon the superior rank and be satisfied to retain the lieutenant colonels and colonels, or otherwise he would lose all. Before deciding the matter, he wanted to obtain my reaction and advice, inasmuch as we had always been in absolute accord on the subject and had consulted each other on all changes of policy. He recited the whole story and, instead of asking my advice as to what his attitude toward a compromise should be, he asked me what I would do under the circumstances. I was deeply concerned at the turn of affairs, and appreciative of the sense of responsibility under which the General was laboring. He had been urged to compromise further. What should he do? He had fought so hard and so long for his precious bill, and by holding out he might lose all, whereas by yielding he might spare something. But he had asked me a question: What would I do? Finally I said: "General, I would not yield another inch." He rose from his chair, rushed over to me, grasped my hand, and said: "I hoped you would say that. In my own mind I had already decided on that course."

We laughed at each other and went over the whole situation. The opposition had told the General that the President might veto the bill because of the supposed attitude of opposition to the Owen-Dyer rider in the War Department. Had we not received a letter from the President months before in which he stated that he favored our bill? Would the President veto it without consulting with us and telling us why? Why not tell him of the rumors, remind him of his promise, and ask him, if he was still of the same opinion, to make his views known to the proper authorities? I communicated with the White House and explained the situation. At noon, while we were holding an executive committee meeting in my office in the Council of National Defense (with General Gorgas, the surgeon general of the Navy, the surgeon general of the Public Health Service, Dr. Victor C. Vaughan, and Dr. William H. Welch present), Admiral Grayson telephoned to me and said that the President had communicated to the proper authorities his wishes as previously written to me. I assumed that our bill would pass unchanged that afternoon, and that the President would sign it.

General Gorgas was not very demonstrative, but in those trying days of the war I do not believe I ever saw him so happy as he was later that day. The Owen-Dyer bill was passed by Congress that afternoon as a rider to the general appropriations bill, and was signed by the President.

V. CONCLUSION

In Gorgas one finds the same outstanding qualities which are the embodiment of the mind and character of every genius. He visualized a conspicuous object that required accomplishment. With an open and untrammeled mind, which could disregard tradition, he utilized the essential materials at hand and conceived a simple formula which enabled him to accomplish his task. With his clear vision and this formula, the direct mind of the genius ignoring all irrelevancies, he proceeded to execute his plans. Then followed the stupendous task of achievement, which required the exercise of patience, tolerance, untiring perseverence that could circumvent unwise opposition, and, finally, unconquerable industry.

Gorgas possessed not only the attributes of a genius, but as well the admirable traits of character that made him a normal man in the midst of conventional surroundings. Gorgas was princely, with the simplicity of a child. He loved his fellowmen to the extent that he saw good in all; and by his tolerant sympathy, he drew men to him who, by the thousands, claimed him as friend. His great work he shared with able contemporaries who were selected by him as aids, and with almost unerring judgment. His pride of proprietorship in his work, if he possessed it at all, was obscured by his desire to accomplish a useful thing, and he utilized every legitimate factor that would bring success to his enterprise. He commanded his great armies of aids, in his civil work as well as in his war work, not by autocratic methods, but by power of persuasion, and by the example of his own industry. In his official life, in his social life, and in his family life, he was the true friend of mankind, the courteous gentleman, and always the cavalier.

FRANKLIN H. MARTIN

BOOK REVIEWS

A CRITIQUE OF NEW BOOKS ON SURGERY

THE active surgeon of the present day, overpressed with the details of his practice and having so little time for even the most necessary study of the ever-widening field of scientific surgery, may be justly accused of neglecting the broadening influence that comes from reading the history and works of our great master surgeons of the past. This deprives him not alone of its cultural advantages but also prevents him from developing the proper perspective of the various problems that present themselves in study and technique.

For this reason American surgery should hold itself fortunate in being presented with a translation of parts of the "Great Surgery" of Guy de Chauliac,[1] and the translator should have the thanks of our entire profession. Written in 1365, this great surgery was the authority for 400 years — a period long enough to look down with cynical amusement upon our vaunted but ephemeral textbooks of today. What system have we now that can boast of sixty printed editions. Sixteen are known in the Latin, forty-three in French, five in Italian, four in Dutch, some in German, some Spanish, and one in English published in 1541 now long forgotten. There are known fourteen complete editions of the Fifteenth Century, thirty-eight of the Sixteenth, seventeen of the Seventeenth Century, besides a large number of abridgments. And yet but for the scholarly devotion of Brennan this great work would have been lost to the average surgeon of our day. He has translated the parts most interesting to us, dealing with wounds, fractures, and dislocations. That Guy de Chauliac was rightly called the Father of Surgery as Hippocrates was called the Father of Medicine, no surgeon will deny after reading the sane and wise directions for the care of patients — and it makes us a little humble to find that many of the principles of surgery that we follow today and thought were discovered in our day, were known and taught by this master surgeon.

The translator has aimed at a literalness in translation and this has at times marred the smoothness of its diction, but this is a captious criticism in view of the great service rendered to American surgery. For its cultural influence, if for nothing else, the book should be in the hands of every surgeon who aspires to be more than a mere technician.

There may be some difference of opinion as to what constitutes a great surgeon — personally I should say, first, honesty; second, industry; third, imagination; and fourth, technical efficiency, but no one could gainsay that Guy de Chauliac in his preface, when he describes what a surgeon ought to be, reached a plane that every modern surgeon should be proud to occupy.

"It is required that the surgeon should know not only the principles of surgery, but also those of medicine in theory and practice; that he should have seen others operate; that he should be ingenious, of good judgment and memory to recognize conditions; and that he be adaptable and able to accommodate himself to circumstances. Let the surgeon be bold in all sure things, and fearful in dangerous things; let him avoid all faulty treatments and practices. He ought to be gracious to the sick, considerate to his associates, cautious in his prognostications. Let him be modest, dignified, gentle, pitiful, and merciful; not covetous nor an extortionist of money; but rather let his reward be according to his work, to the means of the patient, to the quality of the issue, and to his own dignity." A. B. K.

[1] GUY DE CHAULIAC (A.D. 1363): ON WOUNDS AND FRACTURES. Translated and published by W. A. Brennan, A.B., Chicago, 1923.

THIS little monograph on deep roentgen therapy[2] is a well written, clear exposition of the subject, explaining the various theories and methods so that they are easily understood. The statements are brief, but lucid and unprejudiced.

The author does not believe it possible to accept without reservation the statement of Seitz and Wintz, that 110 per cent of the erythema dose is the lethal dose for cancer cells, but it may afford a basis for estimating dosage.

Régaud and Nogier's theory of the specific biological action of rays of different wave lengths is discussed and contrasted with the views of Friedrich and Koenig, who believe the biological action is independent of the wave lengths, depends upon the dose absorbed by the tissues, and is the same for filtered or unfiltered rays.

He discusses in detail the physics of roentgen therapy and explains divergence of the rays in the tissues. Useful suggestions are given to calculate the depth of penetration, using water as a standard of comparison, and useful tables of absorption values are given. Cross fire is explained and evaluated.

He devotes considerable attention to a description of apparatus aad describes the most popular types at length. He also discusses the latest French advances and explains their advantages.

Measurement of dosage is carefully and efficiently

[2] LA RADIOTHÉRAPIE PROFONDE. By Iser Solomon. Paris: Masson & Cie, 19[illegible].

dealt with and the ionization method thoroughly explained. The author's ionometer is described and illustrated.

The work throughout is excellent, concise, clear, and authoritative, is an ideal book for beginners, and will be found of value also to those of experience.

DAVID C. STRAUS.

THIS is the second volume[1] of this work. The first volume, which was published in 1918, dealt with the general consideration of fractures, including treatment. This new volume deals with special fractures, considering each bone separately. The material is divided into seven sections dealing respectively with fractures of the skull, including fractures of the bones of the face; fractures of the vertebræ; fractures of the pelvis; fractures of the ribs and sternum; fractures of the shoulder girdle; fractures of the upper extremities; and fractures of the lower extremities.

The book is very well illustrated with photographs, diagrammatic sketches, and a large number of X-rays of cases demonstrating the points discussed. The numerous diagrammatic sketches, illustrating the mechanism of fracture and the lines of force produced by the action of the various muscles on the fragments, explaining the resultant deformity, are extremely valuable. In the black and white diagrammatic sketches the use of red ink to show the lines of fracture and the lines of muscular force is striking.

Some clever new German methods and apparatus are shown, and, in general, the subject is handled masterfully. Some minor criticisms may be made, as for example in the treatment of fractures of the patella too much stress is laid on the wiring of the fragments. In some cases the details and duration of after-care are not complete. The American and British apparatus and methods are not adequately discussed.

The bibliography refers only to the older fundamental publications and to the recent literature since 1901. As is usual in German publications, the references to British, French, and American literature are disproportionately meager.

The work, as a whole, is one of the best treatises on fractures that has appeared in any language. It gives an excellent idea of the present German methods of treatment, without, however, paying sufficient attention to the methods used in other countries. Nevertheless, it is a book which should be in the hands of all those who are doing special work in fractures.

DAVID C. STRAUS.

[1] DIE KNOCHENBRUECHE UND IHRE BEHANDLUNG; Ein Lehrbuch fuer Studierende und Aerzte. By Dr. Med. Hermann Matti. vol. ii. Die spezielle Lehre von den Knochenbruechen und ihrer Behandlung einschliesslich der komplizierenden Verletzungen des Gehirns und Rueckenmarks. Berlin: Julius Springer, 1922.

AS stated by the authors, the appearance of the second edition of this voluminous work[2] so closely follows its initial publication as to preclude any radical changes in the text or illustrations.

There is no question as to the efficacy of teaching neurology from the standpoint of correlation of anatomic, physiologic, and clinical facts. Unfortunately it has been true that the student has been taught the anatomy and physiology of the nervous system with utter disregard for the fact that these subjects might have been made more interesting by pointing out their clinical significance. On the other hand the diseases of the nervous system are taught by asking the student to recite parrot-like the symptoms and signs of given clinical entities. Successful teaching of neurology must correlate these subjects for the student.

It would seem, however, that the volume under consideration is quite too ponderous for the average undergraduate medical student. There can be no question as to its value and merit as a book of reference for anyone interested in clinical neurology.

LOYAL E. DAVIS.

[2] THE FORM AND FUNCTIONS OF THE CENTRAL NERVOUS SYSTEM. By Frederick Tilney, M.D., Ph.D., and Henry A. Riley, A.M., M.D. 2nd ed. New York: Paul B. Hoeber, 1923.

BOOKS RECEIVED

Books received are acknowledged in this department, and such acknowledgment must be regarded as a sufficient return for the courtesy of the sender. Selections will be made for review in the interests of our readers and as space permits.

DISEASES OF THE RECTUM, ANUS AND COLON. 3 vols. By Samuel G. Gant, M.D., LL.D. Philadelphia: W. B. Saunders Company, 1923.

HYDRO- UND THERMOTHERAPIE VON INNEREN UND NERVEN-KRANKHEITEN. By Dr. Ernst Tobias. Berlin: Urban & Schwarzenberg, 1923.

LEGAL MEDICINE AND TOXICOLOGY. Edited by Frederick Peterson, M.D., LL.D., Walter S. Haines, A.M., M.D., and Ralph W. Webster, M.D., Ph.D. 2nd ed., vols. i & ii. Philadelphia: W. B. Saunders Company, 1923.

COLLECTED PAPERS FROM THE WASHINGTON UNIVERSITY SCHOOL OF MEDICINE. vol. i, 1921. St. Louis: C. V. Mosby Company, 1923.

CLINICS AND COLLECTED PAPERS OF ST. ELIZABETH'S HOSPITAL, RICHMOND, VIRGINIA. vol. of 1922. St. Louis: C. V. Mosby Company, 1923.

TRAITÉ PRATIQUE DE CYSTOSCOPIE ET DE CATHÉTÉRISME URÉTÉRAL. 2d ed. By G. Marion and M. Heitz-Boyer. Paris: Masson et Cie, 1923.

EXPLORATION CLINIQUE ET DIAGNOSTIC CHIRURGICAL. By Felix Lejars. Paris: Masson et Cie, 1923.

LEHRBUCH DER PHYSIKALISCHEN, BIOLOGISCHEN UND KLINISCHEN GRUNDLAGEN ZUR STRAHLEN-TIEFEN-THERAPIE UND IHRER ANWENDUNG IN DER GYNAEKOLOGIE. By Prof. Dr. Ernst von Seuffert. Berlin: S. Karger, 1923.

APPLIED PSYCHOLOGY FOR NURSES. By Donald A. Laird. Philadelphia and London: J. B. Lippincott Company, 1923.

THE TONSILS, FAUCIAL, LINGUAL, AND PHARYNGEAL, WITH SOME ACCOUNT OF THE POSTERIOR AND LATERAL PHARYNGEAL NODULES. By Harry A. Barnes, M.D. St. Louis: C. V. Mosby Company, 1923.

Cerebrospinal Fluid in Health and in Disease. By Abraham Levinson, B.S., M.D. With a foreword by Ludvig Hektoen, M.D. St. Louis: C. V. Mosby Company, 1923.

Epidemiology and Public Health. Vol. II.—Nutritional Disorders, Alimentary Infections and Percutaneous Infections. By Victor C. Vaughan, M.D., LL.D., assisted by Henry F. Vaughan, M.S., Dr. P.H., and George T. Palmer, M.S., Dr. P.H. 3 vols. St. Louis: C. V. Mosby Company, 1923.

Tonsillectomy by Means of the Alveolar Eminence of the Mandible and Guillotine; with a Review of the Collateral Issues. By Greenfield Sluder, M.D. St. Louis: C. V. Mosby Company, 1923.

Anæsthetics in Practice and Theory. By J. Blomfield, O.B.E., M.D. (Cantab.). Chicago: Chicago Medical Book Company, 1923.

Optotypes Consisting of Test-Letters and Pictographs for Measuring the Acuteness of Vision. By John Green, M.D., LL.D., and A. E. Ewing, A.M., M.D. St. Louis: C. V. Mosby Company, 1923.

Chirurgie des Voies Biliaires. By Henri Hartmann, in collaboration with MM. Boppe, Hautefort, Petit-Dutaillis, Renaud, Uhlrich and Virenque. Paris: Masson et Cie, 1923.

First Aid X-Ray Atlas of Fractures and Dislocations. By H. C. Orbin, O.B.E., F.R.C.S. (Edin.). New York: Paul B. Hoeber, 1923.

First Aid X-Ray Atlas of the Arteries. By H. C. Orbin, O.B.E., F.R.C.S.(Edin.). New York: Paul B. Hoeber, 1923.

International Clinics. Edited by Henry W. Cattell, A.M., M.D. Philadelphia: J. B. Lippincott Company, 1923.

The Operative Treatment of Glaucoma. By H. Herbert, F.R.C.S. (Eng.). New York: Messrs. Wood & Company, 1923.

Merck's Manual of the Materia Medica, a Ready Reference Pocket Book for the Physician and Surgeon, compiled and published by Merck & Co., New York, 1923.

The Urethra and the Urethroscope. By F. Carminow Doble, M.R.C.S., L.R.C.P., with foreword by Major A. T. Frost, O.B.E., R.A.M.C. New York: Oxford University Press, 1923.

Practical Local Anesthesia and Its Surgical Technic. By Robert Emmett Farr, M.D., F.A.C.S. Philadelphia and New York: Lea and Febiger, 1923.

Urgent Surgery. By Felix Lejars. 3d Eng. Translation from 8th French ed. By W. S. Dickie, F.R.C.S., and Ernest Ward, M.A., M.D., F.R.C.S. New York: William Wood & Co., 1923.

International Medical Annual; a Year Book of Treatment and Practitioner's Index. New York: William Wood & Co., 1923.

Surgical "Don'ts" (and "Do's"). By C. Hamilton Whiteford, M.R.C.S., L.R.C.P. London: Harrison & Sons, Ltd., 1923.

Collected Papers of the Mayo Clinic. vol. xiv, 1922. Edited by Mrs. M. H. Mellish. Philadelphia: W. B. Saunders Company, 1923.

A Report on the Scientific Work of the Surgical Staff of the Woman's Hospital in the State of New York, vol. iv, 1921–1922. Edited by George Gray Ward, M.D., F.A.C.S. St. Louis: C. V. Mosby Company, 1923.

Chronologia Medica, a Handlist of Persons, Periods and Events in the History of Medicine. By Sir D'Arcy Power, K.B.E., M.B.(Oxon.), F.R.C.S.(Eng.), and C. J. S. Thompson, M.B.E. New York: Paul B. Hoeber, 1923.

Papers from the Mayo Foundation for Medical Education and Research and the Medical School of the University of Minnesota. vol. ii, 1921–1922. Philadelphia: W. B. Saunders Company, 1923.

Excursions into Surgical Subjects. By John B. Deaver, M.D., Sc.D., LL.D., and Stanley P. Reimann, M.D. Philadelphia: W. B. Saunders Company, 1923.

Traité d'Obstétrique. 9th ed.—2 vols. By A. Ribemont-Dressaignes and G. Lepage. Paris: Masson et Cie, 1923.

The Note Book of an Electro-Therapist. By Dr. Mel R. Waggoner. McIntosh Electrical Corporation, Chicago: 1923.

Die Nierenfunktions-Pruefungen im Dienst der Chirurgie. By Dr. Ernst Roedelius. Berlin: Julius Springer, 1923.

Birth Statistics for the Birth Registration Area of the United States. Seventh Annual Report. Washington: Government Printing Office, 1923.

A Clinical Guide to Bedside Examinations. By H. Elias, N. Jagic and A. Luger. Translated and arranged by Dr. Wm. A. Brams. New York: Rebman Company, 1923.

Endocrine Diseases. By Wilhelm Falta. Translated and edited by Milton K. Meyers, M.D. Philadelphia: P. Blakiston's Son & Co., 1923.

JOHN B. MURPHY MEMORIAL

Marshall & Fox, Architects

AMERICAN COLLEGE OF SURGEONS

THE JOHN B. MURPHY MEMORIAL BUILDING OF THE AMERICAN COLLEGE OF SURGEONS

THE construction of the John B. Murphy Memorial Building of the American College of Surgeons is begun, and the corner stone will be laid with appropriate ceremony on Tuesday, October 23rd, at 3:30 p.m. The date has been fixed during the week of the annual Clinical Congress of the American College of Surgeons so that many of the Fellows may be present to participate in this important event which is of such great interest to the College.

The architecture of the building is suggested by the reproduction of the drawing on the opposite page. Competent critics pronounce the design of very unusual merit, reflecting great credit upon the architects, Messrs. Marshall & Fox. The character of the monumental building is clearly indicated by the design, which, when translated into enduring concrete, stone, bronze, and marble, with striking individuality and beauty of detail, will be appropriate not only to the purpose, but will be recognized generally as one of the most evident architectural features of Chicago-beautiful.

The principal feature of the interior will be the Memorial Hall, in every way worthy of, and in harmony with, the exterior. This hall will be in frequent use by the American College of Surgeons and the various medical societies of Chicago and vicinity. Below the main auditorium is planned a small hall of about two hundred seating capacity which will be constantly utilized by committees and the smaller medical organizations for their meetings. The remainder of the building is designed for the requirements of the College, particular attention being given to providing proper facilities for the Library, and for the Literary Research Department which is of rapidly increasing interest and importance on account of the many requests for service from the Fellows.

The completion of this great Memorial Building project marks an epoch in the relations of the medical profession to the general public as evidenced by this monumental structure, built in recognition of scientific services rendered to humanity. To the American College of Surgeons a valuable asset is to be presented, a creation of beauty to become the center of the organized activities of the members of the surgical profession resident on the Western Hemisphere.

The location is in the choice portion of the wonderful development along Michigan Boulevard, north of the river, one block west of the Boulevard, and only a few minutes' walk from the loop. This was very recently the most desirable residential district, and here were clustered the homes of the oldest and most affluent families.

The entire frontage of the block in which the Memorial Building will stand is now practically owned by the College. In the center will rise the beautiful new structure; on the west corner is the remarkable old building for years one of Chicago's show places, now the home of the executive offices of the College; on the east will stand a great modern office building, the home of the official organ of the College, SURGERY, GYNECOLOGY AND OBSTETRICS. When completed these three structures will provide the American College of Surgeons with buildings and facilities which, in beauty and monetary value, will be unequaled by those of any other similar organization in the world.

The ceremony of cornerstone laying will be consistent with the importance of the occasion. William E. Dever, mayor of Chicago, will preside and many other distinguished guests will be present. The Regents of the College and all the Fellows will be invited to participate, wearing the official cap and gown. The many other friends of the College who have contributed to make possible the realization of this project are also particularly urged to be present on this ceremonial occasion.

AN END-RESULT STUDY OF THE CASES OPERATED UPON BEFORE THE TWELFTH ANNUAL MEETING OF THE CLINICAL CONGRESS OF AMERICAN COLLEGE OF SURGEONS AT BOSTON, OCTOBER 24–27, 1922

By ELLIOTT C. CUTLER,[1] M.D., F.A.C.S., Boston

IN his presidential address[2] before the College of Surgeons in October of last year, Dr. Cushing made the following statement:

"The College cannot wish to foster the mere spectacularization of surgery so prevalent in days gone by, and the Boston members have decided to follow again the same course they pursued when the Congress met here before—the only course they can see whereby this tendency can in a measure be offset—namely, by a subsequent report, to be published in the official organ of this body, not only of the immediate but of the late results of all the public operations performed in the Boston hospitals before members of the College at this meeting."

The committee on arrangements for the Boston meeting, in accordance with this statement and with a pre-arranged agreement on the part of all those who participated in the operative clinics before the Congress, are prepared to make the promised report. Each member of the committee who represented a local hospital was made responsible for answering the questionnaires and letters. One member of the committee (the author of the present report) was appointed to assemble the material from the various hospitals after a sufficient number of months had elapsed to justify this final report on as many cases as could be located.

Operations were performed in twenty hospitals in Boston from October 24 to 27, 1922. The daily bulletins printed at the Congress headquarters listed 304 surgical operations in sixteen hospitals. The proportionate distribution of these operations as listed is charted, Table I. Four participating hospitals are not recorded because of insufficient data in the bulletins, viz.:—The Forsyth Dental Infirmary, The Huntington Memorial Hospital, the Massachusetts Charitable Eye and Ear Infirmary, and the Boston Lying-In Hospital.

A preliminary questionnaire was sent out the day after the Congress was over. Reports were

TABLE I.—DISTRIBUTION OF OPERATIONS AT VARIOUS HOSPITALS

Hospitals	Oct. 24	Oct. 25	Oct. 26	Oct. 27	Totals
Boston City	8	6	9	9	32
Massachusetts General	14	13	13	10	50
Peter Bent Brigham	7	9	7	7	30
Children's	9	8	9	7	33
Massachusetts Homeopathic	12	7	8	0	27
St. Elizabeth's	7	4	9	6	26
Carney	3	6	5	0	14
Free Hospital for Women	9	9	8	8	34
New England Deaconess	0	5	6	0	11
Boston Dispensary	1	0	0	0	1
New England Hospital for Women and Children	2	2	0	0	4
Evangeline Booth	0	0	2	0	2
Cambridge	0	5	0	3	8
Long Island	0	7	0	4	11
U.S. Naval	2	4	0	0	6
Beth Israel	1	2	4	8	15
	75	87	80	62	304

Surgical end-results in general. Surg., Gynec. & Obst., 1923, xxxvi, 304.

TABLE II.—COMPARISON OF REPLIES TO QUESTIONNAIRES 1 AND 2

Hospitals	Cases operated upon as reported in preliminary questionnaire, Oct., 1922.	Cases operated upon as reported in final questionnaire, July, 1923.	Maximum number of cases reported in questionnaires 1 and 2.
Boston City	9*	24	24
Massachusetts General	40	46	46
Peter Bent Brigham	30	30	30
Children's	0	27	27
Massachusetts Homeopathic	41	41	41
St. Elizabeth's	21	0	21
Carney	20	23	23
Free Hospital for Women	29	29	29
New England Deaconess	11	11	11
Boston Dispensary	1	0	1
New England Hospital for Women and Children	7	7	7
Evangeline Booth	1	1	1
Long Island	8	8	8
Cambridge	13	13	13
U.S. Naval	6	6	6
Beth Israel	10	10	10
	253	276	298
Lying-In†	1	1	1
The Forsyth Dental Infirmary†	13	0	13
Massachusetts Charitable Eye and Ear Infirmary†	0	15	15
	267	292	327

*Preliminary report covers only one service—final report covers all cases.

†Not included in Table I, therefore cases not added in total for comparison.

[1] Member of the Committee on Arrangements delegated to collect and publish the results obtained in patients operated upon before the Congress.

TABLE III.—DEATHS AND COMPLICATIONS

Hospital	Cases reported	Deaths					Complications			
		Number of deaths	Diagnosis	Operation	Lived post-operative	Cause of death	Number of cases	Diagnosis	Operation	Complications
Boston City	24	1	Gastric ulcer	Gastro-enterostomy	4 days	Hæmorrhage	0			
Massachusetts General	40	2	Fæcal fistula	Closure stoma	24 hours	Senile debility	3	Contraction of the neck	Pedicle graft	Infection and bronchitis
								Cancer sigmoid	Excision of colostomy	Hæmorrhage, urinary drainage through wound and extensive urinary infection
			Cancer of stomach	Pylorectomy	4 days	General peritonitis		Pyelonephrosis	Nephrectomy	Protracted fever
Peter Bent Brigham	50	3	Subtentorial tumor, glioma	Cerebellar exploration	24 hours	Shock	1	Hyperthyroidism	Partial thyroidectomy	Hæmorrhage six hours after operation — operation for control
			?Cholecystitis, ?Malignant disease of intestine	Cholecystectomy and choledochostomy	30 days	Pulmonary embolus				
			Carcinoma of bladder	Partial resection of bladder	4 days	Pneumonia				
Children's	27	1	Embryoma of left kidney	Nephrectomy	1½ hours	Shock	1	Hare-lip and cleft palate (left)	Edges of cleft palate refreshed	Nasopharyngitis, wound infection
Massachusetts Homeopathic	41	3	Hypertrophy of prostate	Suprapubic cystotomy	6 days	General debility	2	Carcinoma of uterus and fibrosis of ovary	Salpingectomy right, oophorosalpingectomy left, hysterectomy	Secondary anæmia persists
			Fibromyoma of uterus	Oophorosalpingectomy, left; salpingectomy, right	6 days	Cardiac		Hernia right, inguinal indirect	Herniotomy right, inguinal	Follicular tonsillitis
			Fibromyoma of uterus and fibrocystoma of of ovary	Hysterectomy supracervical, appendectomy, right salpingectomy and left oophorosalpingectomy	24 hours	Hæmorrhage				
St. Elizabeth's	21	0					0			
Carney	23	2	Carcinoma of uterus	Hysterectomy for ?malignancy	36 hours	Myocarditis and shock	0			
			Carcinoma of stomach	Pylorectomy for carcinoma at pylorus	22 hours	Surgical shock				
Free Hospital for Women	20	0					0			
New England Deaconess	11	0					0			
Boston Dispensary	1	0					0			
New England Hospital for Women and Children	7	2	Carcinoma of bladder	Suprapubic cystotomy	13 days	Acute cardiac dilatation	0			
			Chorio-epithelioma of uterus	Complete supravaginal hysterectomy	16 days	Metastases to lungs and brain				
Evangeline Booth	1	0					1	Pregnancy	Cæsarean section	Phlebitis
Cambridge	13	0					1	?Ovarian tumor	Exploratory laparotomy, appendectomy	Superficial wound infection

TABLE III.—DEATHS AND COMPLICATIONS—*Continued*

Hospital	Cases reported	Deaths					Complications			
		Number of deaths	Diagnosis	Operation	Lived post-operative	Cause of death	Number of cases	Diagnosis	Operation	Complications
Long Island	8	0					0			
U. S. Naval	6	0					2	Gastric ulcer	Gastro-enterostomy	Still has symptoms of active ulcer
								Foreign bodies in right knee	Arthrotomy through the patella	Sepsis of knee ending in bony ankylosis
Beth Israel	15	0					0			
Boston Lying In	1	0					0			
Massachusetts Charitable Eye and Ear Infirmary	15	0					1	Mastoiditis	Right simple mastoid	Pneumonia and empyema
Forsyth Dental Infirmary	13	0					0			
Totals Percentage	327	14 (4.3%)					12 (33.7%)			

received from eighteen of the twenty hospitals that participated. A final questionnaire was sent out in July, 1923, and this time eighteen of the twenty hospitals submitted data in regard to the cases operated upon by their staffs. The number of cases reported on the two occasions is charted on page 564 (Table II), and show an expected discrepancy with the bulletin figures on Table I.

A comparison of Tables I and II shows a very creditable number of cases listed in the reports from the hospitals, and there is enough similarity in the figures given in the bulletin with what was actually performed in the hospitals to make one realize the amount of care put into the publications of the daily bulletins. A shrinkage of only 6 cases is actually very small. Could we obtain careful end-result figures on such a large number of cases much might be learned. However, as has already been suggested, the division of responsibility made this impossible. In spite of professed interest at the time the decision was made to render such a report, there was little enthusiasm in the search for the end-results by the time the final questionnaire was sent out. This was not unforeseen, for those familiar with this pursuit realize the immense amount of labor involved. To be accurate, such reports entail the personal physical examination of each patient and this, in turn, must be preceded by the far more laborious and time-consuming task of finding the patients and getting them to come in for this examination. Letters are frequently unreliable as patients often state that they are well and cured, whereas a physical examination has shown a complete recurrence of the lesion.

It was our plan to obtain a preliminary report immediately following the meeting for two reasons: (1) to get a full and correct list of all operations (the published list was frequently changed after being printed, by emergency cases being added, patients refusing operation, patients not appearing for operation, etc., etc.), and (2) to obtain a list of (a) operative deaths and (b) immediate complications. This report would cover the immediate as compared with the late or final results, and if submitted shortly after the operations were over would be more likely to contain accurate lists of any complications that might have occurred. The immediate results are comprised in the happenings up to the discharge of the patient from the hospital. The number of deaths and the number of complications reported are listed in Table III with a short description of these cases.

Examination of the above groups is of utmost interest and value when the cases are studied

individually. There are also some lessons to be drawn from the figures as groups. Thus a 4.3 per cent mortality figure for a series of major operations (and about 80 per cent can be called such) is certainly disquieting. And six of the fourteen fatalities occurred within the first thirty-six hours after operation! The complications reported vary from simple wound infection to protracted infection, serious hæmorrhage and failure of relief from symptoms. The data submitted by some hospitals, however, was so vague and generalized that no numerical relationship should be drawn.

The final group to be studied includes the reports on all cases upon whom we have obtained information after a period of at least six months following operations. This gives us additional data in regard to (1) the price of surgery and (2) its efficacy as a remedial agent. The difficulty in obtaining such late studies on cases is emphasized by the figures in Table IV where one can compare the number of cases operated upon with the number of cases about which we were able to obtain information after a six months' interval.

TABLE IV.—END-RESULTS AFTER SIX MONTHS

Hospitals	Cases operated upon.	Cases about which information was obtained six months after operation (includes fatalities).
Boston City	24	0
Massachusetts General	46	23
Peter Bent Brigham	30	27
Children's	27	23
Massachusetts Homeopathic	41	34
St. Elizabeth's	21	0
Carney	23	22
Free Hospital for Women	29	23
New England Deaconess	11	5
Boston Dispensary	1	1
New England Hospital for Women and Children	7	6
Evangeline Booth	1	1
Cambridge	13	11
Long Island	8	4
U.S. Naval	6	6
Beth Israel	10	10
Massachusetts Charitable Eye and Ear Infirmary	15	0
The Forsyth Dental Infirmary	13	0
Lying-In	1	1
	327	197

The figures in Table IV show that in 60 per cent of the cases operated upon we were able to obtain some sort of an end-result report. This in itself is not a discouraging figure and there is a certain amount of information of interest and value in the material collected. These late studies should picture the final results of the operations except in so far as they concern the cure of cancer and other malignant tumors.

The 197 cases may be briefly classified as follows:

	Cases	Per cent
Dead	17*	8.6
Unimproved	18	9.
Improved	125	63.4
Well	37	18.7
	197	

*Three cases in addition to those reported above under fatalities, died:
1. June, 1923—Cancer œsophagus with local and general extension (Massachusetts Homeopathic Hospital case).
2. March, 1923—Gall bladder at time of Congress—Death due to rupture of rectal wall, no cancer, no previous symptoms (Long Island Hospital case).
3. May, 1923—Cancer of breast at the time of Congress—Death due to cardiorenal disease (Cambridge Hospital case).

The above tabulation will have to speak for itself since it would be impossible for any individual who was not first-hand conversant with all the cases to render any reliable opinion regarding what cases were or were not correctly judged as well, as improved, unimproved, etc. Of the deaths we are certain and also of some adverse results as pictured in the few complications quoted above. Much was lacking from some of the reports while others were models of careful observations. That only 82 per cent of the cases are improved at the end of 6 months gives food for much thought.

There are obviously many things this report does not pretend to cover, such as the erroneous pre-operative diagnoses, the comparative seriousness of the operations undertaken, and what influence the fact of operations under the disadvantageous circumstances of crowded amphitheaters may have had upon the results. Even as it stands very important lessons may be drawn from it.

CLINICAL CONGRESS OF AMERICAN COLLEGE OF SURGEONS

THIRTEENTH ANNUAL SESSION, CHICAGO, OCTOBER 22–26, 1923

HARVEY CUSHING, Boston, *President* ALBERT J. OCHSNER, Chicago, *President-Elect*
FRANKLIN H. MARTIN, Chicago, *Director-General*

LOCAL EXECUTIVE COMMITTEE

ALLEN B. KANAVEL, *Chairman*

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PHILIP H. KREUSCHER
NELSON M. PERCY
HERBERT A. POTTS

PLANS FOR THE CLINICAL MEETING IN CHICAGO

WEEK'S PROGRAM IN BRIEF

Monday, October 22

10–12. Hospital Conference, Gold Room, Congress Hotel. Papers and discussions.
2–5. Hospital Conference, Gold Room, Congress Hotel. Round table conference.
8. Presidential Meeting, Orchestra Hall. Inaugural address of President-Elect and Murphy Oration on Surgery.

Tuesday, October 23

9–12. Clinics and demonstrations at the hospitals and medical schools.
10–12. Hospital Conference, Florentine Room, Congress Hotel. Papers and discussions.
2–4. Clinics and demonstrations at the hospitals and medical schools.
2–5. Hospital Conference, Florentine Room, Congress Hotel. Round table conference.
3:30. Laying of corner stone of Murphy Memorial.
8. Scientific session, Gold Room, Congress Hotel. Papers and discussions.

Wednesday, October 24

9–12. Clinics and demonstrations at the hospitals and medical schools.
2–5. Clinics and demonstrations at the hospitals and medical schools.
8. Scientific session, Gold Room, Congress Hotel. Papers and discussions.

Thursday, October 25

9–12. Clinics and demonstrations at the hospitals and medical schools.
2–4. Clinics and demonstrations at the hospitals and medical schools.
4. Annual meeting of the Fellows of the American College of Surgeons, Gold Room, Congress Hotel.
8. Scientific session, Gold Room, Congress Hotel. Papers and discussions.

Friday, October 26

9–12. Clinics and demonstrations at the hospitals and medical schools.
2–5. Clinics and demonstrations at the hospitals and medical schools.
8. Eleventh Convocation of the American College of Surgeons, Auditorium Theater.

THE thirteenth annual session of the Clinical Congress of the American College of Surgery formally opens with the Hospital Conference on Monday morning at 10 o'clock in the Gold Room of the Congress Hotel, the conference being continued during the afternoon.

Beginning on Tuesday morning and continuing through the following three days, the clinics of Chicago will be open to the visiting surgeons, for whose benefit a carefully planned series of clinics and demonstrations has been prepared.

At the presidential meeting on Monday evening in Orchestra Hall, the President-Elect, Dr. Albert J. Ochsner, will be inaugurated and deliver the annual address. On this occasion, the distinguished foreign guests will be presented and Dr. George W. Crile of Cleveland will deliver the John B. Murphy oration in surgery.

A series of scientific meetings has been arranged for Tuesday, Wednesday, and Thursday evenings to be held in the Gold Room of the Congress Hotel, at which papers dealing with surgical subjects of timely interest will be read and discussed by eminent surgeons of the United States and Canada and distinguished visitors from Europe and South America.

Two special evening sessions are being arranged for those particularly interested in ophthalmology, otology, laryngology and rhinology, to be held in the Florentine Room on Tuesday and Wednesday evenings.

The eleventh convocation of the American College of Surgeons will be held in the Auditorium Theater on Friday evening, at which fellowship in the College will be conferred upon a group of American and Canadian surgeons and honorary fellowship upon the distinguished foreign visitors.

CLINICAL PROGRAM

The preliminary program of clinics and demonstrations to be given during the Chicago meeting will be found in the following pages. This program is to be further revised and amplified previous to the meeting so that the final program will completely present the clinical activities of this great medical center. All departments of surgery are to be represented therein: General surgery; gynecology; obstetrics; orthopedics; urology; surgery of the eye, ear, nose, throat, and mouth; experimental surgery; surgical pathology; roentgenology, etc.

Of very great interest will be a series of clinical demonstrations or "dry clinics" to be given in many of the hospitals in which internists, pathologists, and others will participate.

The real program of the Congress will be issued daily during the meeting. It will be posted each afternoon on the bulletin boards in the Elizabethian Room giving in complete detail the cases to be operated upon or demonstrated. A printed program will be distributed each morning containing the complete clinical program for the day and for the evening session, and other announcements.

CONGRESS HEADQUARTERS

General headquarters for the Congress will be established at the Congress Hotel where the Gold, Florentine, Elizabethian, French, and St. Francis rooms, together with the foyers and other rooms adjacent thereto on the first and second floors, have been reserved for the exclusive use of the Congress. These rooms will be utilized for evening meetings, registration and ticket bureaus, bulletin rooms, etc.

Headquarters will be open for registration at 8 a.m., Monday, October 22, and each morning thereafter at the same hour.

The clinical program for Tuesday will be bulletined during Monday afternoon and reservation for clinic tickets for Tuesday's clinics may be filed late that afternoon.

HOSPITAL CONFERENCE

The annual Hospital Conference will be held Monday and Tuesday at the Congress Hotel. The sessions on Monday will be held in the Gold Room beginning promptly at 10 a.m. and at 2 p.m., and on Tuesday in the Florentine Room at the same hours. The program for this Conference, which is published in the following pages, it will be noted, deals intimately with the details of hospital standardization and management.

The program is interesting throughout including addresses, papers, demonstrations, round-table conferences and general discussions by hospital superintendents, trustees, surgeons, nurses, and others interested in the conduct of hospitals, and will be most practical, providing so far as possible a solution for many of the everyday problems and difficulties encountered in hospital management and the care of the patient in the hospital.

At the Monday morning session, Dr. Franklin H. Martin, the Director-General, will make the annual announcement of those hospitals which appear on the approved list for 1923.

Among the new features introduced this year, possibly none will be of greater interest or more useful than the Hospital Service Bureau where detailed information will be given out and inquiries answered either verbally or by written communication.

Headquarters for the Hospital Standardization Department and the Hospital Service Bureau, together with the office of Dr. M. T. MacEachern, Associate Director in charge of hospital standardization, will be established in the French Room on the mezzanine floor adjacent to general headquarters of the Congress.

Hospital standardization headquarters will be open daily during the entire session of the Clinical Congress and those who are particularly interested in hospital problems are requested to register there upon arrival in Chicago.

REDUCED RAILWAY FARES

The railways of the United States and Canada have authorized the sale of round-trip tickets to Chicago on account of the Clinical Congress at one and one-half the ordinary one-way fare, provi-

ded that the journey be made by the same route in both directions.

Round-trip tickets at the reduced rate will be sold to members only upon presentation of identification certificates issued from the office of the Director-General. Such identification certificates will be issued to all who register in advance, one certificate being sufficient for the individual surgeon and dependent members of his family. Under this arrangement, round-trip tickets will be sold from October 18 to 24 in the central and eastern states and eastern Canada with a final return limit of November 1. In the far western states and the western provinces of Canada, the earliest selling date is October 16 with a return limit of November 3.

The reduction in fares does not apply to Pullman fares or to excess fares charged for passage on certain trains. Local railway agents will supply detailed information in regard to routes, rates, etc.

MEETING OF ORAL SURGEONS

The third annual meeting of the American Association of Oral and Plastic Surgeons will be held in the Rose Room at the Congress Hotel on Monday and Tuesday, October 22 and 23. An interesting program has been arranged and those interested in this department of surgery are cordially invited to be present. Truman W. Brophy, M.D., President; Henry Sage Dunning, M.D., Secretary and Treasurer.

LIMITED ATTENDANCE—ADVANCE REGISTRATION

Because of the popularity of these annual clinical meetings it has been found necessary in recent years to adopt the plan of limiting attendance. This plan necessitates registration in advance on the part of all who wish to attend. The limit of attendance is based upon the result of a survey of the amphitheaters, lecture rooms, and laboratories in the several hospitals and medical schools as to their capacity for accommodating visitors. When the limit of attendance has been reached through advance registration no further applications will be accepted, hence the necessity for early registration. It is to be expected that the limit of attendance will be reached some weeks in advance of the meeting.

CLINIC TICKETS

Attendance at all clinics and demonstrations is controlled by means of special clinic tickets, which are issued at headquarters each morning at 8 o'clock for that day's clinics. The use of clinic tickets has proven an efficient means of providing for the distribution of the visiting surgeons among the several clinics and insuring against overcrowding, as the number of tickets issued for any clinic is limited to the capacity of the room in which that clinic is to be given.

A complete detailed schedule of the day's clinics will be posted on bulletin boards at headquarters during the afternoon of the preceding day. After the program has been so posted, reservations for tickets for the next day's clinics may be filed, the tickets to be issued the following morning at 8 o'clock. A printed program will be issued each morning which will contain the complete clinical program for the day, with announcements of evening sessions and other information.

CHICAGO HOTELS AND THEIR RATES

While the hotels of Chicago have a large capacity for the entertainment of visitors, it is well for those expecting to attend the Congress to make reservation of hotel accommodations at the earliest possible date. The following hotels are recommended by the local committee:

	Minimum Rate Single Room	
	With Bath	Without Bath
Atlantic	$3.50	$2.00
Auditorium	5.00	2.50
Blackstone	5.00	4.00
Brevoort	3.00	2.00
Chicago Beach	4.00	3.00
Congress	4.00	3.00
Cooper-Carlton	3.50	....
Drake	5.00	....

	Minimum Rate Single Room	
	With Bath	Without Bath
Edgewater Beach	$3.00	$....
Fort Dearborn	2.45	1.95
Great Northern	3.50	2.50
LaSalle	4.00	2.50
Lexington	3.00	2.00
Morrison	4.00	....
Planters	3.00	2.00
Sherman	3.00	2.00

PROGRAM FOR EVENING MEETINGS

Presidential Meeting, Monday, October 22—Orchestra Hall, 8 P.M.

Address of Welcome: Allen B. Kanavel, M.D., Chicago, Chairman of Committee on Arrangements.

Address of the Retiring President: Harvey Cushing, M.D., Boston.

Introduction of foreign guests: Sir William I. de Courcy Wheeler, President Royal College of Surgeons in Ireland, Dublin; A. E. Webb-Johnson, C.B.E., D.S.O., F.R.C.S., London.

Inaugural Address: Albert J. Ochsner, M.D., Chicago.

The Doctor John B. Murphy Oration in Surgery—George W. Crile, M.D., Cleveland: "A Biophysical Law Governing Surgical Mortality."

Tuesday, October 23—Gold Room, Congress Hotel, 8 P.M.

Sir William I. de Courcy Wheeler, Dublin, Ireland:

James T. Case, M.D., Battle Creek: Significance and Value of Deep Roentgen Therapy.

Symposium: Thoracic Surgery.

Evarts A. Graham, M.D., St. Louis: Principles Concerned in the Treatment of Acute and Chronic Empyema.

Wyman Whittemore, M.D., Boston: Etiology and Treatment of Non-Tuberculous Pulmonary Abscess.

Carl A. Hedblom, M.D., Rochester, Minn.: Extrapleural Thoracoplasty in the Treatment of Bronchiectasis.

Discussion: Emil G. Beck, M.D., and D. B. Phemister, M.D., Chicago.

Wednesday, October 24—Gold Room, Congress Hotel, 8 P.M.

A. E. Webb-Johnson, C.B.E., D.S.O., F.R.C.S., London: Kinks of Surgical Importance.

Symposium: Hæmorrhage.

George Neil Stewart, M.D., D.Sc., Cleveland: General discussion.

F. N. G. Starr, M.D., Toronto: Postoperative Hæmorrhage.

Arthur Dean Bevan, M.D., Chicago: Gastric Hæmorrhage.

John G. Clark, M.D., Philadelphia: Uterine Hæmorrhage.

William E. Lower, M.D., Cleveland: Hæmorrhage in the Genito-Urinary Tract.

Fred H. Albee, M.D., New York: Rehabilitation Surgery.

Discussion: Harry E. Mock, M.D., and Edwin W. Ryerson, M.D., Chicago.

Thursday, October 25—Gold Room, Congress Hotel, 8 P.M.

Symposium: Pain.

William D. Haggard, M.D., Nashville: The Surgical Significance of Pain.

James M. Patton, M.D., Omaha: Pain as the Result of Surgical Lesions in the Eye.

John F. Barnhill, M.D., Indianapolis: Pain Due to Lesions of the Intracranial Structure.

Frank M. Sulzman, M.D., Troy, N. Y.: Pain in the Ear.

R. D. Kennedy, M.D., Globe, Arizona: Pain in the Joints and Back.

Richard R. Smith, M.D., Grand Rapids: Pain in the Distal Regions of the Body Due to Gynecological Affections.

A. J. Crowell, M.D., Charlotte, N. C.: Pain of the Genito-Urinary Organs.

T. Casey Witherspoon, M.D., Butte: Pains in the Chest and Upper Abdominal Regions.

William J. Mayo, M.D., Rochester, Minn.: The Co-ordination of Human Vegetative Functions.

Convocation, Friday, October 26—Auditorium Theater, 8 P.M.

Invocation: Rev. John Timothy Stone, D.D.

Conferring of Honorary Fellowships.

Presentation of Candidates for Fellowship.

Presidential Address: Albert J. Ochsner, M.D., Chicago.

Fellowship Address.

HOSPITAL CONFERENCE

MONDAY, OCTOBER 22, GOLD ROOM, CONGRESS HOTEL

HARVEY CUSHING, M.D., Boston, President, Presiding

Morning Session, 10 to 12:30

Opening Address by the President.

The American College of Surgeons and Better Hospitals for the Sick. FRANKLIN H. MARTIN, M.D., Chicago, Director-General of American College of Surgeons.

The 1923 Survey—Problems and Conclusions from a Study Thereof and Plans for 1924. MALCOLM T. MACEACHERN, M.D., Chicago, Associate Director of American College of Surgeons, in charge of Hospital Standardization.

Hospital Standardization and the Medical, Nursing, and Hospital Professions. REV. C. B. MOULINIER, S. J., Milwaukee, President of Catholic Hospital Association.

Hospital Standardization and the Community Hospital. JOHN B. MCKENZIE, M.D., Logieville, New Brunswick, Surgeon to Miramichi Memorial Hospital, Newcastle, and Hôtel Dieu Hospital, Chatham, New Brunswick.

Sidelights on Hospital Standardization from the Hospital Surveyor. E. W. WILLIAMSON, M.D., Chicago, Hospital Visitor, 1923.

Approved Hospitals a Factor in Advancing Scientific Medicine. D. ALLAN CRAIG, M.D., Chicago, Associate Director of American College of Surgeons, in charge of State and Provincial Activities.

A Review of the Present Status of Nursing in the United States and Canada with Possible Future Developments. ISABELLE M. STEWART, R.N., New York, Assistant Professor of Nursing, Columbia University; and JEANE BROWN, R.N., President of Canadian National Association of Trained Nurses, Toronto.

A Comparison—The Care of the Patient in the Standard versus the Non-Standard Hospital. ROBERT JOLLY, Superintendent of Baptist Hospital, Houston, Texas.

Afternoon Session, 2 to 4:30

The Value and Need of More Attention to End-Results and Follow-Up in Hospitals To-Day. GEORGE GRAY WARD, JR., M.D., New York, Professor of Obstetrics and Gynecology, Cornell University Medical College; Chief Surgeon, Woman's Hospital.

The Registry of Bone Sarcoma as an Example of the End-Result Idea in Hospital Organization. ERNEST A. CODMAN, M.D., Boston, Massachusetts.

A Scheme for Surgical Rating. ERNEST LEROI HUNT, M.D., Worcester, Massachusetts, Surgeon and Director of Surgical Service, Worcester City Hospital.

The Problem of the Hospital Interne. A. R. WARNER, M.D., Chicago, Executive Secretary, American Hospital Association.

Round Table Conference—Conducted by FRANK D. JENNINGS, M.D., Brooklyn, New York. Topics for discussion: Individual signing of fee-splitting pledge. Single interpretation of anti-fee-splitting pledge. Effect of fee-splitting on continuance of hospital on approved list. Remedy for failure to keep hospital records. Routine pathological analyses and basis on which charges should be made. Ratio of internes and nurses to patients. Location of X-ray and clinical laboratory in relation to service. Necessity of having record clerk, clinical and X-ray laboratory technicians; might not one person suffice in hospital under 100 beds. Overcoming difficulties of interne service. Advantages of hospital standardization movement.

TUESDAY, OCTOBER 23, FLORENTINE ROOM, CONGRESS HOTEL

A. J. OCHSNER, M.D., President, Presiding

Morning Session, 10 to 12

Symposium—Hospital Standardization.

Staff Organization: (1) Fundamental principles in selecting and organizing a hospital staff. (2) The staff conference agenda and procedure. (3) Difficulties encountered and how to overcome them. (4) Discussion.

Case Records: (1) Organization of a case record department. (2) The component parts of a good record. (3) The securing, supervising, and filing of records. (4) Essentials in nurses' records. (5) Difficulties encountered and how to overcome them. (6) Discussion.

Afternoon Session, 2 to 4:30

Symposium—Hospital Standardization (*continued*).

The Clinical Laboratory: (1) Organization and scope of service. (2) The laboratory technician. (3) Laboratory records. (4) Methods of laboratory charges. (5) Discussion.

The X-Ray Department: (1) Organization and scope of work. (2) The X-ray technician. (3) Interpretation of findings. (4) X-ray records. (5) Discussion.

Round Table Conference—Conducted by E. S. GILMORE, Superintendent, Wesley Hospital, Chicago. Topics for discussion: Responsibility and liability of hospitals. Doctor's orders. Access to patients' records. Anæsthesia in hospitals. Pre-operative cases. Record of infections. Appraising of hospital records. System of nomenclature. Booking operations. Computing hospital death rates. What are the advantages of a physiotherapy department?

PRELIMINARY CLINICAL PROGRAM

COOK COUNTY HOSPITAL

Operative clinics, daily, morning and afternoon. Pathological conference, daily, 11. Clinical demonstrations will be given as follows:

F. A. BESLEY—Sarcoma of the extremities, with exhibit of cases.

W. R. CUBBINS—Indications for enterostomy in intestinal obstruction.

VERNON DAVID—Osteomyelitis in children; also local recurrence in carcinoma of the rectum.

GEORGE DAVENPORT—Demonstration: Ventriculography in brain lesions.

G. G. DAVIS—Injuries of the spine and spinal cord.

F. G. DYAS—Carcinoma of the stomach.

D. N. EISENDRATH—Cases illustrating surgery of the kidney and ureter.

HARRY JACKSON—Rôle of intracranial pressure in injuries of the brain and skull.

E. J. LEWIS—Early management of compound fractures.

HUGH MCKENNA—Cases of fracture of the neck of the femur.

R. W. MCNEALY—Aneurism of the aorta and peripheral vessels.

KARL MEYER—Acute perforating ulcers of the stomach.

PAUL OLIVER—Carcinoma of the breast.

K. SPEED—Standardization of fracture treatment; arthroplasty.

D. C. STRAUS—Diagnosis and treatment of cholecystitis and cholelithiasis.

GEORGE THOMPSON—Common-duct stones.

R. T. VAUGHAN—Lung abscess.

BERTHA VAN HOOSEN—Gynecological and obstetrical cases.

ST. LUKE'S HOSPITAL

Tuesday, October 23

JOSEPH A. CAPPS, JOSEPH L. MILLER, A. R. ELLIOTT, ROBERT B. PREBLE, and M. C. GILBERT—9. Diagnostic clinics.

GEORGE W. HALL—9. Neurosurgical cases.

EDWARD L. JENKINS—9. Roentgenological demonstration.

EDWIN F. HIRSCH—9. Pathological demonstration.

NORVAL H. PIERCE, G. PAULL MARQUIS, EDWARD P. NORCROSS, J. T. CAMPBELL, WALTER H. THEOBALD, and JOHN A. CAVANAUGH—2. Skiagraphs of the mastoid in relation to disease. Indications for operation in acute mastoid inflammation with demonstration of operative technique.

Wednesday, October 24

L. L. MCARTHUR—9. General surgery.

T. J. WATKINS, A. H. CURTIS, and H. O. JONES—2. Gynecological clinic.

Thursday, October 25

THOMAS L. GILMER—9. Oral surgery.

WILLIAM HARSHA and S. C. PLUMMER—10. General surgery.

J. L. PORTER, E. W. RYERSON, H. B. THOMAS, and P. LEWIN—2. Orthopedic clinic.

Friday, October 26

A. E. HALSTEAD—9. General surgery.

J. L. PORTER, E. W. RYERSON, H. B. THOMAS, and P. LEWIN—2. Orthopedic clinic.

MICHAEL REESE HOSPITAL

Tuesday, October 23

D. N. Eisendrath—9. Kidney and bladder operations.
A. A. Strauss—9. Gastric and duodenal ulcer cases, operations. Pyloric stenosis.
Edmund Andrews—9. Hernia operations and demonstration of cases.
Charles Jacobs, M. A. Bernstein, and James Patejdl—9. Orthopedic clinic, operations and demonstration of cases.
Harry Kahn—9. Ultraviolet rays in diseases of the nose and throat.

Wednesday, October 24

E. Wyllys Andrews—9. General surgical operations.
Louis A. Greensfelder—9. Thyroid operations.
David C. Strauss—9. Fracture and osteomyelitis clinic, operations and demonstration of cases.
Ralph Bettman—9. Surgery of the chest.
Lester E. Frankenthal—9. Gynecological and obstetrical operations.
Irving Stein—9. Gynecological and obstetrical operations: pneumoperitoneum.
Ludwig Simon—9. Obstetrical operations.
Jerome Strauss—2. Nose and throat clinic.

Thursday, October 25

Emanuel Friend—9. Gall-bladder operations.
D. N. Eisendrath—9. Kidney and bladder operations.
George L. Davenport—9. Ventriculography. Brain tumor cases.
Harry Jackson—9. Management of acute cranial injuries.
Joseph L. Baer—9. Gynecological and obstetrical operations; capillaroscopy.
Julius E. Lackner—9. Gynecological and obstetrical operations.
William Rubovitz—9. Gynecological and obstetrical operations.
Harry Kahn—9. Ultraviolet rays in disease of the nose and throat.
Robert Sonnenschein—9. Nose and throat clinic.
Ira Frank—2. Nose and throat clinic.

Friday, October 26

L. A. Greensfelder—9. Thyroid operations.
D. C. Strauss—9. Gall-bladder cases.
A. A. Strauss—9. Gastric and duodenal ulcer cases.
L. E. Schmidt, G. Kolischer, I. S. Koll, J. S. Eisenstaedt, and H. Katz—9. Genito-urinary clinic, operations and demonstration of cases.
Robert Sonnenschein—9. Nose and throat clinic.

NELSON MORRIS INSTITUTE FOR RESEARCH

Tuesday, October 23

Louis A. Greensfelder—2. Thyroid clinic, demonstration of cases.
David C. Strauss—2. Recent advances in the treatment of fractures and osteomyelitis, with special reference to children.
Ralph Bettman—2. Thoracic surgery, with demonstration of cases.

Wednesday, October 24

D. N. Eisendrath—2. Kidney and bladder cases.
A. A. Strauss—2. Demonstration of cases: Stomach resections for gastric and duodenal ulcer by the Pólya and Billroth I and II methods; longitudinal resection of lesser curvature with pyloric sphincter resection.
D. C. Strauss—2. Recent advances in gall-bladder surgery.

Thursday, October 25

Emanuel Friend, Edmund Andrews, George L. Davenport, and Harry Jackson—2. Demonstration of cases: Billroth II operation for carcinoma of stomach Sarcoma of skull. Pyrogoff amputation, 2 cases, for endarteritis obliterans. Gall-bladder operations.
Edmund Andrews—2. Hernia clinic, demonstration of cases.

Daily

O. T. Schultz—2. Pathological demonstrations.
B. Portis—2. Protective mechanisms of the omentum.
W. Bloom—2. Experimental studies in obstructive jaundice.
W. H. Rosenau—2. Clinical and experimental studies on liver function.
Robert A. Arens—2. Demonstrations in X-ray department: Recent advances in the new high voltage treatment of surgical cases with special reference to precise methods of measuring X-ray quantity. Cases of sarcoma treated by the higher voltage. Exhibit of plates showing surgical lesions.

ST. JOSEPH'S HOSPITAL

Tuesday, October 23

Hugh McKenna—9. Inguinal hernia, appendectomy, gall bladder, bone transplant for non-union, demonstration of author's fracture table.
A. A. Hayden—9. Stacke operation for chronic purulent mastoiditis; suture of pillars for control of hæmorrhage in tonsillectomy; demonstration of head bandages; correction of external nasal deformities; carcinoma of tonsil, demonstration of patient, pictures and microscopic sections.
Charles McKenna—10. Vasotomy, prostatectomy, nephrectomy, inguinal hernia.
Truman Brophy—10. Cleft palate and hair-lip cases.

Wednesday, October 24

Thomas O'Donohue—9. Demonstration: Cases of resection of sigmoid for malignancy with X-ray pictures before and after operation; cases of multiple diverticulitis of large bowel.
Frank David—9. Hæmorrhoids, fistula of rectum.
Oscar Ofner—10. Conservative or radical treatment of inflammatory adnexa of the uterus.
W. H. G. Logan—10. Cleft palate and hair-lip cases.
W. Grosvenor, Fred Rohr, and L. W. Martin—Demonstration of obstetrical technique with manikin.

Thursday, October 25

J. Z. Bergeron—9. Canfield antrum operation, frontal sinus operation, tonsillectomies.
J. Holinger—10. Bexold mastoid operation.
Frank B. McCarthy—10. Abdominal operations.

SPECIAL DEMONSTRATIONS

L. E. Hines—Pathological findings in a fatal case of heart disease associated with pregnancy.
William H. Burmeister, Leland Shafer, and F. O. Frederickson—Medico-surgical cases with fluoroscopy of the chest and following bismuth meals.
E. L. Jenkinson—Daily, 3. Demonstrations in the use of deep X-ray therapy.

AUGUSTANA HOSPITAL

Tuesday, October 23

N. M. Percy—9. General surgery.
Dennis W. Crile—2. Fracture clinic.

Wednesday, October 24

A. J. Ochsner—9. General surgery.
E. H. Ochsner—9. General surgery.
Rudolph Oden—2. General surgery.
Rudolph Holmes—3:30. Obstetrical clinic.

Thursday, October 25

N. M. Percy—9. General surgery.
John Nuzum—2. General surgery.

Friday, October 26

A. J. Ochsner—9. General surgery.
E. H. Ochsner—9. General surgery.
Alfred Murray—2. Sinus clinic.

MERCY HOSPITAL

Tuesday, October 23

J. F. Golden, C. F. Sawyer, and E. L. Moorhead—9. General surgery.
G. W. Mahoney—9. Eye clinic.
L. D. Moorhead—2. General surgery.
H. Dooley—2. Genito-urinary clinic.

Wednesday, October 24

Philip H. Kreuscher—9. Bone and joint clinic, operations and demonstration of cases.
E. L. Moorhead and F. E. Pierce—9. General surgical operations.
Henry Schmitz—9. Gynecological clinic.
R. J. Tivnen—9. Eye, ear, nose, and throat clinic.
John D. Claridge—2. Bone and joint clinic.
C. Larkin—2. General surgery.

Thursday, October 25

E. L. Moorhead and C. F. Sawyer—9. General surgery.
Philip H. Kreuscher—9. Bone and joint clinic.
R. J. Tivnen—9. Eye, ear, nose, and throat clinic.
H. Dooley—2. Genito-urinary clinic.
J. F. Golden—2. General surgery.

Friday, October 26

Philip H. Kreuscher—9. Special arthroplasty clinic.
Henry Schmitz—9. Gynecological clinic.
John F. Golden—9. General surgery.

Daily

Staff—9–5. Out-patient clinics. X-ray demonstrations.

ILLINOIS MASONIC HOSPITAL

Tuesday, October 23

John R. Harger—9. Surgical clinic.

Wednesday, October 24

N. H. Lowry—9. Demonstration of perivertebral anæsthesia in abdominal surgery; cholecystectomy, partial gastrectomy, appendectomy.
E. W. White—10:30. Urological clinic.
Alva Sowers—2. Eye clinic.

Thursday, October 25

LeRoy Thompson—9. Nose and throat clinic.

WESLEY MEMORIAL HOSPITAL

Tuesday, October 23

Mark T. Goldstine—9. Vaginal plastics.
Staff—2. Dry clinic: J. Gordon Wilson—Differentiation between labyrinthine and cerebellar disease. Otis H. Maclay—Ethmoid infections. C. B. Younger—Sinus infections. C. F. Bookwalter—The intranasal operation on the tear sac.

Wednesday, October 24

Allen B. Kanavel—9. Brain tumor. Plastics on the hands and face. Goiter.
John A. Wolfer—2. Gastric surgery.

Thursday, October 25

William E. Schroeder—9. Breast tumors. Kidney surgery.
Paul B. Magnuson—2. Bone grafts in the spine. Operations on old fractures of the os calcis. Injuries about the shoulder, elbow, and wrist joint.

Friday, October 26

H. M. Richter—9. Gall-bladder diseases. Goiter and stomach cases.
V. D. Lespinasse—2. Sterility cases.
Charles B. Reed—3:30. Measurements of the fetus in utero. Induction of labor and bag work.

LUTHERAN DEACONESS HOSPITAL

Tuesday, October 23

E. E. Henderson and G. H. Schroeder—9. General surgery, diagnostic and operative clinic.

Wednesday, October 24

S. Dahl—9. General surgery.
I. Pilot—9. The habitat and distribution of hæmolytic streptococci and their rôle in surgical infections.

Thursday, October 25

A. E. Kanter—9. Gynecological clinic.

Friday, October 26

E. E. Henderson and G. H. Schroeder—9. General surgery, diagnostic and operative clinic.
R. Householder—9. X-ray diagnosis of surgical conditions.

UNIVERSITY HOSPITAL

Tuesday, October 23

E. V. L. Brown—9. Eye clinic.
C. C. Rogers—10. General surgery.

Wednesday, October 24

Harry Culver—9. Urological clinic.
Charles Davison—10. General surgery, cases of undescended testicle.
Charles Davison—2. General surgery.

Thursday, October 25

J. P. Sprague—9. Orthopedic surgery.
Karl A. Meyer—10. General surgery, gastro-intestinal cases.

Friday, October 26

William E. Gamble—9. Eye clinic.
C. S. Bacon—10. Obstetrical clinic.

U. S. VETERAN'S HOSPITAL No. 76

Tuesday, October 23

PAUL BROWN—9:30. General surgical operations.

Wednesday, October 24

H. L. KRETSCHMER—9:30. Genito-urinary clinic, operations and demonstrations of cases.

D. B. PHEMISTER—2. Cranioplasty, operation. Clinical demonstrations: Compression of spinal cord by tumor in von Recklinghausen's neurofibromatosis. Plastic operations on the face. Treatment of chronic empyema.

Thursday, October 25

PAUL BROWN—9:30. Operations and demonstration of cases.

EDWIN W. RYERSON—2. Orthopedic clinic: Resection of hip for tuberculous arthritis, operation. Demonstration of cases.

ST. MARY'S HOSPITAL

Tuesday, October 23

D. A. ORTH and GEORGE MUELLER—9. General surgery.

H. SCHMITZ, H. BUNDY, and J. LAIBE—9. Radium clinic.

F. B. LUSK—2. Laboratory demonstrations.

C. CHALLENGER—2. X-ray demonstrations.

Wednesday, October 24

N. M. PERCY, O. E. NADEAU, W. A. KEWFLEWSKI, and T. Z. XELOWSKI—9. General surgery.

J. J. KILLEEN—2. Ear, nose, and throat clinic.

G. W. MAHONEY—2. Eye clinic.

Thursday, October 25

A. J. OCHSNER, D. A. ORTH, GEORGE MUELLER, and O. E. NADEAU—9. General surgery.

D. W. CRILE—2. Orthopedic clinic.

Friday, October 26

R. E. FLANNERY, E. PATERA, M. J. SEIFERT, and C. STOTZ—9. General surgery.

J. WELFELD—2. Genito-urinary and skin clinic.

CHICAGO MEMORIAL HOSPITAL

Tuesday, October 23

DAVID S. HILLIS and J. E. FITZGERALD—9. Obstetrical clinic.

JULIA C. STRAWN and A. E. KANTER—10. Gynecological clinic.

STAFF—2. Eye, ear, nose, and throat clinic.

Wednesday, October 24

H. R. CHISLETT, CHARLES E. KAHLKE, PETER S. CLARK, R. A. MELENDY, P. M. OLIVER, and W. M. HANCHETT—9. General surgical clinic.

D. N. EISENDRATH, J. M. MALTMAN, and D. G. BRUNJES—11. Genito-urinary clinic.

Thursday, October 25

DENNIS W. CRILE—9. Orthopedic clinic.

JULIA C. STRAWN, A. E. KANTER, DAVID S. HILLIS, and J. E. FITZGERALD—11. Gynecological and obstetrical clinic.

STAFF—2. Eye, ear, nose, and throat clinic.

Friday, October 26

STAFF—9. Presentation of borderline cases from all departments.

CHILDREN'S MEMORIAL HOSPITAL

Tuesday, October 23

ALBERT H. MONTGOMERY—2. General surgery.

THOMAS GALLOWAY—2. Nose and throat clinic.

Wednesday, October 24

M. HANCHETT—9. General surgical operations

WALTER C. BURKET—2. General surgery.

EDWIN W. RYERSON and ROBERT O. RITTER—3. Orthopedic operations.

Thursday, October 25

THOMAS GALLOWAY—10:30. Nose and throat operations.

EDWIN MILLER and ERNEST MCGILL—2. General surgery.

JOHN C. WILLIAMS—2. Nose and throat clinic.

Friday, October 26

ALBERT H. MONTGOMERY—9. General surgical operations

M. HANCHETT—2. General surgery.

EDSON FOWLER—3. Orthopedic clinic.

WASHINGTON BOULEVARD HOSPITAL

Wednesday, October 24

B. F. LOUNSBURY and A. R. METZ—9. General surgery.

B. F. LOUNSBURY, A. R. METZ, B. C. CORBUS, and V. J. O'CONOR—2. Diathermy in the treatment of cancer of the bladder; electro-coagulation of carcinomata. Operations and demonstrations of cases, methods, and cystoscopic examinations of apparently cured cases.

Thursday, October 25

B. F. LOUNSBURY and A. R. METZ—9. General surgery.

B. F. LOUNSBURY, A. R. METZ, B. C. CORBUS, and V. J. O'CONOR—2. Diathermy in the treatment of cancer of the bladder; electro-coagulation of carcinomata. Operations and demonstration of cases, methods, and cystoscopic examinations of apprently cured cases.

ST. ANTHONY'S HOSPITAL

Tuesday, October 23

LAWRENCE RYAN—9. Plastic surgery, operative clinic.

F. J. E. EHRMANN, JOSEPH ZABOKRTSKY, and S. E. DONLON—2. General surgical clinic.

Wednesday, October 24

F. J. E. EHRMANN, JOSEPH ZABOKRTSKY, S. E. DONLON, and J. J. SPRAFKA—9. General surgical operations.

LAWRENCE RYAN—2. Dry clinic, plastic surgery.

EVELYN EHRMANN and F. B. OLENTINE—2. Laboratory demonstrations.

Thursday, October 25

LAWRENCE RYAN, R. C. CUPLER, JOSEPH ZABOKRTSKY, and F. B. OLENTINE—9. General surgical operations.

OTTO JIRSA—2. Demonstration of genito-urinary cases.

L. S. TICHY—2. X-ray demonstration.

Friday, October 26

J. E. STANTON, F. J. FARA, ROBERT HARDIE, and J. C. STUBBS—9. Staff meeting with presentation of cases.

JOHN THEOBALD and H. M. THOMETZ—2. Nose and throat clinic.

MAX WEISSKOPF—2. Obstetrical clinic.

GRANT HOSPITAL

Tuesday, October 23

JACOB FRANK, A. G. ZIMMERMAN, and WILLIAM HESSERT—General surgery.
ERNST SAURENHAUS, E. W. FISCHMANN and C. S. BACON—Gynecology and obstetrics.
J. HOLINGER and G. T. VON COLDITZ—Eye, ear, nose, and throat.
L. E. SCHMIDT—Urology.
G. EDWIN BAXTER—Pediatrics.

Wednesday, October 24

SYLVAN COOMBS and H. EDWARD SAUER—General surgery.
W. A. STUHR and JULIUS E. LACKNER—Gynecology and obstetrics.
GEORGE J. DENNIS and O. H. KRAFT—Eye, ear, nose, and throat.
P. G. KITTERMAN—X-ray.

Thursday, October 25

F. H. PIRNAT and WILLIAM HESSERT—General surgery.
THEODORE WILD—Eye, ear, nose, and throat.
ERNST LACKNER and FRANKLIN J. CORPER—Pediatrics.

Friday, October 26

A. G. ZIMMERMAN, LEON FEINGOLD, JOHN SIEBEL, and ARTHUR FRY—General surgery.
C. S. BACON—Gynecology and obstetrics.
LUDWIG ABELE and G. T. VON COLDITZ—Eye, ear, nose, and throat.

WOMEN'S AND CHILDREN'S HOSPITAL

Tuesday, October 23

ANNA BLOUNT—9. General surgery.
MARGUERITE JONES and NORA RAGER—9. Nose and throat clinic.
BERTHA SHAFER—2. Syphilis clinic.
EFFA V. DAVIS, RHODA P. BARSTOW, and JOHANNA HEUMANN—3. Pediatric clinic.

Wednesday, October 24

LENA K. SADLER and JULIA STRAWN—9. General surgery.
LILLIAN E. TAYLOR and GERTRUDE THOMPSON—9. Nose and throat clinic.
SARAH M. HOBSON, CLARA FERGUSON, ARMINA HILL, MARIE ORTMAYER, and ELIZA MORSE—2. Medico-surgical clinic.

Thursday, October 25

ALICE CONKLIN—9. General surgery.
KATHERINE B. RICH and ROSE Z. BENNET—9. Nose and throat clinic.
STAFF—2. Cancer clinic: MAUD SLYE—Heredity of cancer. HELEN B. FLYNN—Infection of cancer and serum treatment. MARY E. HANKS—X-ray treatment of cancer. WALBURGA KACIN—Emetin treatment in cancer. Radium treatment

Friday, October 26

BERTHA E. BUSH and MARY J. KEARSLEY—9. General surgery.
JANE F. BEEM and H. STEPHENS-WALKER—9. Nose and throat surgery.
RACHEL S. YARROW, PEARL M. STETLER, VESPER R. SHAFFER, LOUISE ACRES, HELGA RUUD—2. Obstetrical clinic. Demonstration of twilight sleep.

COLUMBUS HOSPITAL

Tuesday, October 23

J. R. PENNINGTON—9. Rectal diseases.
M. M. RITTER—11. Eye, ear, nose, and throat clinic.
W. H. O. HOFFMAN—2. Pediatric clinic.
S. R. PIETROWICZ—3. Medico-surgical cases.
J. DAMIANI—4. Roentgenological diagnosis.

Wednesday, October 24

DANIEL A. ORTH, W. B. GERHARD, T. A. CARTER, WILLIAM SADLER, M. J. SEIFERT, and L. C. QUINN—9. General surgical clinic.
J. E. H. ATKEISSON—2. Anæsthesia.
W. H. GEHL—3. Genito-urinary surgery.
C. W. BARRETT—4. Gynecological clinic.

Thursday, October 25

FREDERICK MUELLER—9. Orthopedic clinic.
LENA SADLER—11. Gynecological and obstetrical clinic.
O. W. MCMICHAEL—2. Medico-surgical cases.
HAROLD MOYER—3. Neuro-surgical cases.
C. O. GETTY—4. Laboratory demonstrations.

Friday, October 26

DANIEL A. ORTH, W. B. GERHARD, T. A. CARTER, WILLIAM SADLER, M. J. SEIFERT, and L. C. QUINN—9. General surgical clinic.
C. O. LINDSTROM—2. Eye, ear, nose, and throat clinic.
JOSEPH WELFELD—3. Dermatology.
L. P. KUHN—4. Industrial surgery.

Daily at 8:30

Emergency drill by surgical nurses.

LOYOLA UNIVERSITY MEDICAL SCHOOL

Tuesday, October 23

LLOYD ARNOLD—2. Demonstration in pathology and bacteriology of surgical interest.

Wednesday, October 24

M. T. STRONG and T. T. JOBE—2. Demonstration in anatomy.

Thursday, October 25

S. A. MATTHEWS—2. Demonstration in physiology.

Friday, October 26

W. C. AUSTIN—2. Demonstration in chemistry.

EYE AND EAR INFIRMARY

Tuesday, October 23

M. GOLDENBURG and R. VON DER HEYDT—2. Eye clinic.
H. R. BOETTCHER—2. Ear, nose, and throat clinic.

Wednesday, October 24

D. C. ORCUTT—2. Eye clinic.
N. H. PIERCE—2. Ear, nose, and throat clinic.

Thursday, October 25

E. K. FINDLAY—2. Eye clinic.
U. J. GRIM—2. Ear, nose, and throat clinic.

Friday, October 26

H. W. WOODRUFF—2. Eye clinic.
S. M. HAGER—2. Ear, nose, and throat clinic.

PRESBYTERIAN HOSPITAL

A. D. Bevan, Dean Lewis, Carl B. Davis, D. B. Phemister, Gatewood, V. C. David, H. L. Kretschmer, R. H. Herbst, G. L. McWhorter, Edward Miller, A. H. Montgomery, F. B. Moorehead, C. A. Parker—General surgery, urology, orthopedics.
N. S. Heaney, Carey Culbertson, W. F. Hewitt—Gynecological clinics.
W. H. Wilder and assistants—Eye clinics.
G. E. Shambaugh and assistants—Nose and throat clinics.

NORTH CHICAGO HOSPITAL

Carl Beck and J. Frederick Harvey—Surgery of duodenal ulcer. Functional plastic operations on the extremities.
Emil G. Beck—Treatment of cancer by open method.
Benjamin H. Orndoff and staff—Diagnostic clinic: Pneumoperitoneum and X-ray.
Joseph C. Beck, Harry L. Pollock and Francis L. Lederer—Eye, ear, nose and throat operations, and demonstration of cases.

RAVENSWOOD HOSPITAL

Tuesday, October 23

Darwin Pond—9. General surgery. Fracture cases.

Wednesday, October 24

Clark A. Buswell—9. General surgery. Laparotomies, tonsillectomies.

Thursday, October 25

G. W. Green and G. N. Bussey—9. General surgery. Goiter cases and laparotomies.

MT. SINAI HOSPITAL

H. M. Richter—Surgery of the thyroid and the bile tracts.
V. L. Schrager—Abdominal surgery, hernia cases.

THE BREMERMAN HOSPITAL

L. W. Bremerman, William Yonker, and Dr. Holmes—daily, 9 and 12. Urological clinics.

SOUTH SHORE HOSPITAL

Tuesday, October 23

Axel Werelius and Weller van Hook—9. General surgery.

Wednesday, October 24

Axel Werelius and Weller van Hook—9. General surgery.

HOME FOR DESTITUTE CRIPPLED CHILDREN

Tuesday, October 23

Elvin J. Berkheiser—2. Orthopedic clinic.

Wednesday, October 24

Charles A. Parker—2. Orthopedic clinic.

Thursday, October 25

Jacob Meyer—2. Orthopedic clinic.

Friday, October 26

Elvin J. Berkheiser—2. Orthopedic clinic.

HENROTIN HOSPITAL

Tuesday and Thursday, October 23 and 24

Burton Haseltine, Gilbert Fitz-Patrick, A. H. Waterman, A. W. LaForge, Clifford Mitchell, and Theodore Proxmire—2:30. Symposium on bronchial asthma with exhibition of cured cases. Discussions by Drs. Paul Hohly, Toledo, Ohio, H. M. Goddard, Philadelphia, and I. O. Denman, Toledo, Ohio.

ST. ANNE'S HOSPITAL

Tuesday, October 23

B. W. Mack, George W. Post, Jr., Thomas E. Meany, and J. J. McGrory—9. General surgical operations.

Wednesday, October 24

George W. Post, Jr., B. W. Mack, and J. J. McGrory—9. Dry clinic.

Thursday, October 25

B. W. Mack, H. J. Dooley, and George W. Post, Jr.—9. General surgical operations.

FRANCES WILLARD HOSPITAL

Tuesday, October 23

French Cary—2. Genito-urinary clinic.

Wednesday, October 24

Frank D. Moore—2. General surgery.

Thursday, October 25

Bertha van Hoosen—9. Gynecology and obstetrics.
Victor L. Schrager—2. General surgery.

LYING-IN HOSPITAL

J. B. DeLee, D. S. Hillis, D. F. Monash, E. L. Cornell, D. A. Horner, and Anna R. Lapham—Daily, 2. Obstetrical clinic.

SURGERY, GYNECOLOGY AND OBSTETRICS

AN INTERNATIONAL MAGAZINE, PUBLISHED MONTHLY

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THE END-RESULTS IN NEARLY THREE HUNDRED CASES IN WHICH THE GALL BLADDER WAS DRAINED—NOT REMOVED

BY H. LAURAN DARNER, M.D., BALTIMORE

WITH AN INTRODUCTION BY THOMAS S. CULLEN, M.D., F.A.C.S., BALTIMORE

From the Gynecological Department of the Johns Hopkins Hospital and the Johns Hopkins Medical School

TWENTY years ago there was much discussion as to when to operate and when not to operate in acute appendicitis. A wide difference of opinion also existed as to what should be done when a co-existent peritonitis was present. The subject was thrashed out at medical meetings and in the literature for several years, with the result that there is now a pretty general unanimity of opinion as to just what procedures are indicated in the various stages of appendicitis.

What applied to appendix operations two decades ago holds good to some extent for gall-bladder operations today. In the beginning nearly all gall bladders were drained. Later it was found that some of these patients suffered from a return of their gall-bladder infection or more stones developed, necessitating a second operation, so that very naturally the question arose: "Why not remove the gall bladder at the first operation and prevent further trouble?" And so firmly convinced were some surgeons that this was the proper procedure that they resected the gall bladder in nearly every case in which they found trouble. In many clinics this has become the routine procedure, and yet in the minds of many surgeons there has been a lurking suspicion that cholecystectomy might not be the wise thing in all cases, but that each case should be judged on its merits. Hence, there is now a tendency on the part of many in some cases to drain and in other cases to remove the gall bladder.

A follow-up of the cases has clearly demonstrated that a certain percentage of patients will have subsequent trouble no matter whether the gall bladder has been drained or whether it has been removed.

Cholecystectomy on a patient who is in good condition certainly gives brilliant immediate results, and furthermore it eliminates the postoperative drainage which for a few days may be so abundant that the dressings are continually soaked, causing great discomfort.

In many of my early cases the gall bladder was so firmly glued to surrounding structures that its removal was impossible, and in quite a number of cases where it was gangrenous I was afraid to attempt a cholecystectomy, feeling that it was unwise to dissect inflamed tissues and leave raw areas through which the infection might readily be disseminated. In such cases I limited myself to cutting away the gangrenous area and then draining. These patients, unless desperately ill at the time, promptly recovered and the majority of them remained well.

Bearing these cases in mind I contented myself with drainage of the gall bladder instead of removal. Of course, when the gall bladder was very large the major portion of it was cut away prior to introduction of the tube. In a no small percentage of the cases I felt that the drainage of bile, particularly where there was thickening and induration in the region of the pancreas, was almost as important as the removal of the gall stones. Nor could I quite get away from the feeling that it was probably unwise to remove the only switch from a single track road. This "switch" might be very valuable for anastomosis into the stomach or duodenum should the main line subsequently become blocked.

Some 2 or 3 years ago I felt it would be wise to take stock and see just what had been accomplished in our drainage cases. Dr. Darner went over my case books and found records of 296 cases. Six of these were ruled out, as a cholecystectomy had been done on account of the possibility of cancer. As will be learned from Dr. Darner's paper, in 17 the gall bladder was gangrenous, in 104 the process was acute, in 144 relatively quiescent at the time of operation, and in 25 the condition was found when the abdomen was opened for some other lesion.

Dr. Darner was indefatigable in his endeavors to trace all these gall-bladder patients, and in all but 14 cases he was successful.

His tabulation shows that 29 patients died shortly after operation, 14 were not located, 19 were unimproved, 26 were markedly improved, but had some symptoms, while the remaining 202 had had no gall-bladder symptoms after operation and were either well or had died of some other disease, the nature of this disease being specified in nearly every case.

Of the 29 immediate deaths, as shown by Dr. Darner's table, 17 were due to desperate complicating pre-operative conditions. This leaves 12 cases, 4.14 per cent, in which death was due to unlooked for postoperative complications. Under "patients that recovered but were not benefited by operation" Darner records 19 patients, 16 of whom I had operated upon. In the remaining 3 the first operation had been performed elsewhere. A perusal of this portion of the paper will give the reader a clear idea of the cases in our series in which drainage of the gall bladder was a failure.

As our series embraces a period of 25 years, we should naturally expect a number of deaths during this long interval. Thirty-four patients died from causes in no way associated with the previous gall-bladder trouble. This is clearly shown in Dr. Darner's tabulation.

There are living at the present time

Unimproved	16
Improved	26
Well	168
	210

Dr. Darner in his article has aimed to give the exact facts so that, after going through the individual protocols, the reader may judge for himself just what has been accomplished. He has in the main refrained from making any deductions.

I hope that all surgeons will shortly report their end-results in their gall-bladder cases. Of course, in clinics in which many acute gall-bladder infections are encountered, the immediate mortality will be infinitely greater than in those where quiescent cases supply the bulk of the operations.

In due time we shall get the proper perspective and be able to determine with some degree of accuracy when to drain and when to remove the gall bladder.

It is perfectly clear that the subject is not yet settled. I personally am deeply interested in this question from the standpoint of the patient. In 1915 I had my own gall bladder drained after removal of a large number of stones from the gall bladder and cystic duct. Later on more stones formed and the gall bladder was excised (February 28, 1923).

In conclusion I want to express my sincere thanks to Dr. Darner for his painstaking labor in locating and analyzing such a large percentage of my gall-bladder cases.

THE purpose of this paper is to present the postoperative results in a large series of gall-bladder conditions. The cases in this series include only those in which the surgical procedure consisted in drainage of the gall bladder. No attempt will be made to discuss the symptoms nor shall we give any review of the voluminous literature on the subject.

Every patient in this series was operated upon by Dr. Thomas S. Cullen. The cases studied cover a period of about 25 years. The ultimate results have improved year by year, thanks to our increased knowledge of the subject and to further refinements in the operative technique. The series being from the operative service of one and the same person will naturally give more uniform results than if the operations had been performed by various surgeons.

In the past 25 years (to July, 1921) Dr. Cullen has had 296 operative gall-bladder cases. The major portion of these operations were performed at the Church Home and Infirmary in Baltimore, the Cambridge, Frederick, and Hagerstown hospitals. Of the 296 operations, 6 must be ruled out because in these malignancy was suspected and the gall bladder with or without a wedge of liver was removed. The remaining 290 cases may be divided into the following groups:

		Cases
1.	Acute gangrenous cholecystitis	14
2.	Acute gangrenous cholecystitis, ruptured	3
3.	Chronic cholecystitis and cholelithiasis (acute exacerbation)	104
4.	Patients who had had frequent typical gall-bladder attacks but in whom the gall-bladder condition was quiescent at the time of operation	144
5.	Cases in which gall stones were detected at the time of a pelvic operation or in the course of an appendectomy	25
		290

Now and then the pelvic or the appendix symptoms are so marked that other abdominal lesions are for the time being overshadowed and the operator is somewhat surprised to find gall stones in addition to what he is looking for. In questioning these patients afterward, some of them give a history of definite gall-bladder symptoms in years past. It is quite possible that of the 25 patients whose gall-bladder conditions are tabulated as accidental findings, some at least had had symptoms in years gone by.

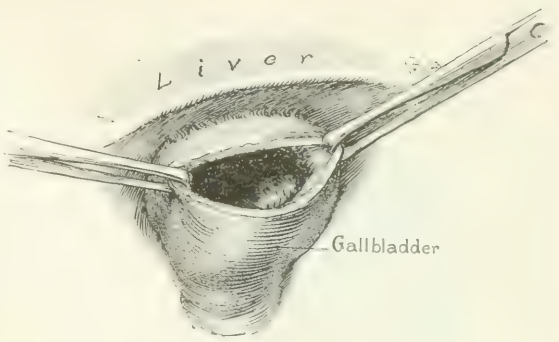

Fig. 1. The gall bladder held open.

METHOD OF DRAINING THE GALL BLADDER

Dr. Cullen has all along felt that it was very essential to drain the gall bladder in such a way as to leave a minimal chance for the formation of postoperative adhesions. In the main he has followed the technique graphically shown by Mr. Broedel in the accompanying pictures.

In Figure 1 we see the gall bladder being held open with forceps. In Figure 2 the rubber tube is being sutured into the gall bladder; mattress or whip-over sutures of fine or medium plain catgut are used and the needle goes through into the lumen of the rubber tube. After the edge of the gall bladder has been whipped over all the way round, we have the picture indicated in Figure 3. A purse-string of catgut passing through the outer walls of the gall bladder is now placed, as shown in Figure 4. After this is tied, we have the picture shown in Figure 5—the tube fitting snugly into the gall bladder with only one catgut ligature visible.

Two flat cigarette drains are placed just below the gall bladder. The gauze does not come quite to the end of the drain. This minimizes the possibility of the drains becoming adherent and causing the patient unnecessary pain when they are removed. One flat drain is taken out on the second day, the other on the third day. The tube usually comes away between the tenth and thirteenth

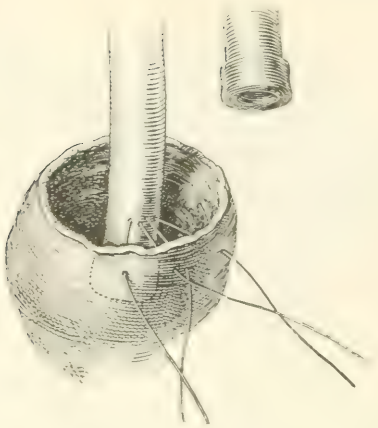

Fig. 2. Suture of the rubber tube into the gall bladder. As small a tube as is deemed safe is employed. Its end is rolled back, as indicated in the upper sketch, and with whip-over or mattress sutures the cut edge of the gall bladder all the way around is controlled. Each suture or every other one goes through the lumen of the tube.

days. The finer the catgut used, the sooner the tube becomes free.

With this technique there should be few adhesions. Of course, it is not always possible to make this ideal closure of the gall bladder. The abdominal wound is usually healed at the end of the third or fourth week.

FINAL RESULTS

Letters were sent to the patients, to their physicians, or to their relatives, and we were fortunate in getting definite data relative to all but 14 patients. In brief, the results were as follows:

		Cases
Immediate deaths		29
Patients not located		14
Unimproved by drainage — treated subsequently —		
Not operated on second time	6	
Cholecystectomy with death	3	
Cholecystectomy with no improvement	1	
Cholecystostomy, not improved	3	
Cholecystostomy, improved	2	
Cholecystostomy, well	4	19
Markedly improved		26
Well, or free from gall-bladder symptoms until death from some other disease		202
		290

IMMEDIATE DEATHS

The immediate death rate was 10 per cent (29 cases). By this we mean that of all the patients, regardless of their pre-operative condition, who had cholecystostomy performed, 29 died in the hospital. Our tabulation of deaths makes clear the cause of so heavy a death rate. When one considers the desperate pre-operative condition in 17 of the cases, this is by no means excessive. In 11 of these 17 cases there were pre-operative complications which made the prognosis bad, while in the other 6 there was inoperable malignancy and the operation was merely palliative for relief of obstruction. This leaves only 12 cases, 4.14 per cent, in which death was due to unforseen postoperative complications.

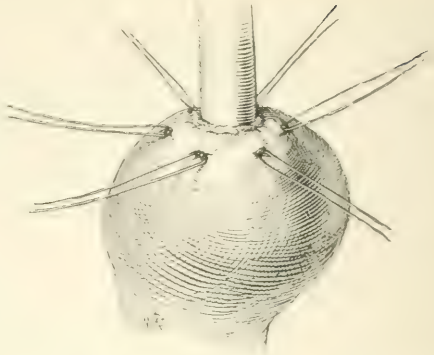

Fig. 3. The rubber tube sewn into the gall bladder.

PRE-OPERATIVE COMPLICATIONS RESPONSIBLE FOR DEATH

		Cases
Endocarditis and septicæmia (streptococcus viridans)		1
Hypertrophic cirrhosis of liver		1
Acute pancreatitis with fat necrosis and ascites		1
Diabetes mellitus		1
Acute cholecystitis, ruptured, general peritonitis		1
Cardiorenal conditions		6
Carcinoma, inoperable (palliative operation for relief of obstruction)		
Carcinoma of pancreas	3	
Carcinoma of gall bladder	2	
Carcinoma of pylorus	1	6
		17

POSTOPERATIVE COMPLICATIONS CAUSING DEATH

Cardiac failure	3
Pulmonary emboli	2
Septicæmia	1
Postoperative shock	3
Postoperative pneumonia	1
Exophthalmic goiter	1
Acute hernia	1
	12

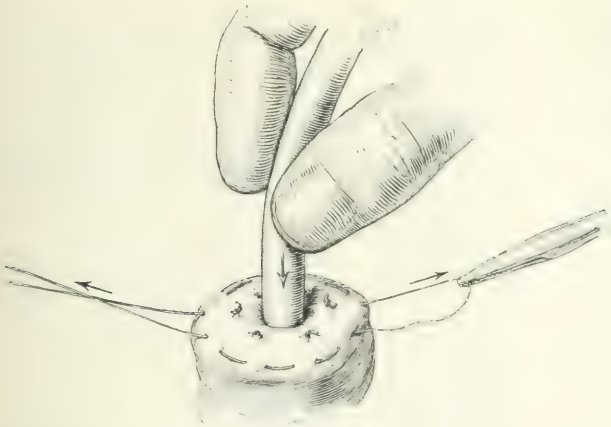

Fig. 4. Placing the purse-string suture around the tube in the gall bladder.

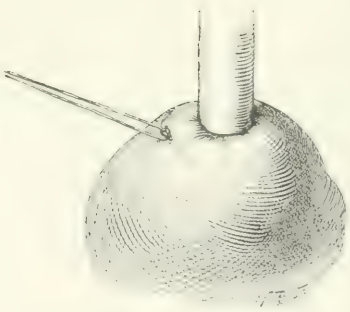

Fig. 5. The appearance of the rubber tube in the gall bladder after the purse-string suture has been tied.

It may be interesting to review the cases included in the tabulation which show the pre-operative complications which were responsible for death.

Case 1. Dr. C. A. P. May 12, 1919. The patient had been ill for a month before the gall-bladder condition developed. During this time both Dr. L. F. Barker and Dr. William S. Thayer had seen him and a diagnosis of streptococcus viridans endocarditis and septicæmia was made. Blood cultures had been repeatedly positive. One month after the onset of this condition the patient developed such excruciating gall-bladder symptoms that both the consultants advised a gall-bladder operation despite the grave prognosis. At operation numerous stones were found, several of which were incarcerated in the cystic duct. The patient was much relieved for 6 weeks, but after this his condition became progressively worse and he died 7 weeks after operation. Death was thought to be due entirely to the streptococcus infection.

Case 2. Mr. T. O. H. June 1, 1919. The patient had been quite ill for 8 months and recently had been using increasingly large amounts of morphine. The condition suggested a chronic cholecystitis and cholelithiasis with frequent exacerbations. At operation the gall bladder was found to be quite large and filled with tarry bile, but there were no stones. The liver was described as showing a most typical example of hypertrophic cirrhosis. The patient, who was in a desperate condition, failed to rally following operation and died 4 hours later.

Case 3. Mrs. M. H. M. April 22, 1917. The patient had had diabetes for many years, but restricted diet had taken care of the condition very well. She had been acutely ill for only 24 hours and the operator in his pre-operative note said: "The patient reminds me of an acute pancreatitis I saw 25 years ago." At exploration 1000 cubic centimeters of straw-colored fluid escaped from the peritoneal cavity. Adipose tissue was dotted with tubercle-like areas of fat necrosis. The gall bladder contained large amounts of dark bile and stones. The patient rallied slightly but died about 15 hours after operation.

Case 4. Mr. W. E. W. June 19, 1910. The patient had had severe diabetes for years, but for several days before he came to us had had excruciating gall-bladder pain with pyrexia and leucocytosis (white blood cells, 18,000). At operation an acute cholecystitis was found. He died 4 days later in diabetic coma.

Case 5. Mrs. M. L. April 20, 1913. The patient had a severe acute nephritis at the time of operation.

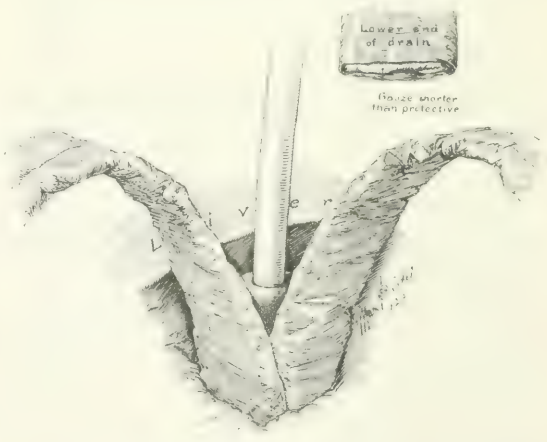

Fig. 6. Two flat cigarette drains laid below the gall bladder, one to be removed on the second the other on the third day. The gauze does not come quite to the edge of the drain. The drains overlap one another. In the picture they are drawn apart in order that their relation to the gall bladder may be seen.

The operation was undertaken on the advice of Drs. T. R. Brown and E. H. Gaither, who felt that it was the only hope of saving her life. There was quite an acute cholecystitis. The patient rallied well after the operation but died 37 days later with nephritis.

Case 6. Mr. W. C. March 18, 1904. The patient had been sick for 3 weeks and at the time of operation there was evidence of a general peritonitis. The gall bladder had ruptured and there was about 300 cubic centimeters of turbid fluid in the peritoneal cavity. He died a few hours later.

Case 7. Mrs. J. B. August 8, 1908. There was an acute gall-bladder condition with pyrexia and a leucocytosis. The patient had a severe acute nephritis at the time of operation. She died 3 days later in uræmic coma.

Case 8. Mr. C. N. November 17, 1907. Acute cholecystitis and pancreatitis. Death from nephritis one day after operation.

Case 9. Mr. W. C. V. October 29, 1908. Mitral insufficiency with partial cardiac decompensation. At operation there was an acute gall-bladder condition with pyrexia, leucocytosis, and jaundice. The abdomen contained 3 liters of bile-stained fluid. The gall bladder was acutely inflamed and six times the normal size. Death 3 days after operation of cardiac failure.

Case 10. Mr. W. M. June 17, 1919. The patient had chronic nephritis. There was an acute gall-bladder condition at the time of operation, with many stones. There was an exacerbation of the renal condition after the operation. Death on the sixth day, probably due to cerebral hæmorrhage.

Case 11. Mr. William H. R. June 21, 1920. The patient had a pre-operative cardiac and renal history. Gall-bladder symptoms had existed for 15 years. The present attack was of 3 weeks' duration; at operation 300 stones were found and perforation of the gall bladder. Death on the fifteenth day with a cardiorenal picture.

Case 12. Mr. G. A. W. July 21, 1917. Operation for relief of obstruction of the common duct. Carcinoma of the head of the pancreas was found at operation. It had already completely obstructed the common duct and there were several nodules in the liver.

Case 13. Mrs. M. M. July 14, 1911. Complete obstruction of the common duct. Large nodule in liver. Head of pancreas carcinomatous. Death a few weeks after operation.

Case 14. Mrs. F. J. S. April 15, 1914. Carcinoma of the head of the pancreas with complete obstruction of the common duct. Death after 1 week from postoperative pneumonia.

Case 15. Mr. J. R. January 3, 1907. Carcinoma of gall bladder found at operation with extension to liver and periportal lymph glands. Death 3 days after operation.

Case 16. Mrs. E. M. H. July 19, 1917. The gall bladder had been drained and stones removed 12 years before. Recurrence of symptoms with considerable loss of weight. Carcinoma of gall bladder found at operation. Cholecystectomy. Local recurrence soon after operation and death followed.

Case 17. Mr. E. H. January 3, 1913. An exploratory operation showed perforation through a carcinoma of the pylorus. Posterior gastro-enterostomy. Removal of stones and drainage of gall bladder. Death on the following day.

All of these 17 patients presented either an almost hopeless prognosis from the time they were first seen, or the operation was undertaken merely as a palliative measure.

A review of the cases with postoperative complications causing death, follows:

Case 1. Mrs. J. C. T. November 24, 1909. Aged 59. Arteriosclerosis. She did well after operation but died shortly after leaving the hospital from "weakness."

Case 2. Mrs. McA. October 30, 1909. Uncomplicated operation for stones. Following operation there was a cardiac break; death 6 days later.

Case 3. Mrs. J. McC. December 14, 1903. Aged 62. Uncomplicated operation for stones. Cardiac decompensation on third day following operation. Death.

Case 4. Mrs. C. E. F. April 23, 1917. A very fat woman. Forty stones found at operation. The gall bladder contained 100 cubic centimeters of viscid fluid Death 1 week after operation, the clinical picture suggesting a pulmonary embolus.

Case 5. Mrs. R. C. A. May 13, 1919. Appendectomy and removal of gall stones. Death on the eighth day from pulmonary embolus confirmed at autopsy.

Case 6. Mrs. F. W. McA. April 23, 1921. Acutely ill at time of operation. White blood cells 30,000. Temperature 102°. Gall bladder gangrenous, contained one large stone. Death 18 days after operation. The autopsy showed multiple lung and brain abscesses.

Case 7. Mrs. E. C. November 22, 1904. The patient failed to rally after a gall-bladder operation. Death attributed to shock.

Case 8. Mrs. J. H. February 27, 1910. Very ill at the time of operation. Temperature 104°. Pulse 150. White blood cells 30,000. History of pneumonia, 10 weeks before operation. The patient failed to rally after operation.

Case 9. Mrs. W. B. B. May 15, 1914. Aged 55. Jaundiced for past 6 months. At the time of operation she had a bronzed color. Gall bladder markedly enlarged on palpation. Failed to rally after operation for removal of stones.

Case 10. Mrs. W. February 6, 1904. Suspected rupture of the gall bladder. Stone removed from gall bladder. Ruptured right pus tube found. Postoperative pneumonia. Death on third day.

Case 11. Mrs. H. H. W. April 1, 1918. The patient had a definite exophthalmic goiter. Definite gall-bladder symptoms with jaundice and clay-colored stools. Operation uncomplicated. Death in 4 weeks from thyroid intoxication.

Case 12. Mr. J. H. February 17, 1910. Definite history. Stones found in gall bladder at operation. Patient discharged from hospital at end of third week. There was still a small drainage sinus at that time. During a paroxysm of coughing the incision broke down. His physician treated the protruding viscera with bichloride compresses. Neither the hospital nor the surgeon was notified. The patient soon died.

Of the patients who recovered but were not benefited by the operation, we find that 19 patients reported that their symptoms had not been relieved by the first operation. Thirteen of these have undergone subsequent gall-bladder operations while the remaining 6 have had only medical treatment. In these 6 cases the presence or absence of a gall-bladder lesion was questionable at the time of the original operation and exploration was only undertaken because of a definite pelvic condition or definite appendiceal symptoms and signs. Then through a McBurney or a mid line suprapubic incision the gall bladder was palpated and a definite lesion made out. Since operation in these six cases, the vague gastro-intestinal symptoms which were present before operation have not been relieved. The primary gall-bladder symptoms were never severe, and it was only the presence of another abdominal condition that caused the patient to submit to operation. Since operation these vague symptoms have returned, but they are not severe and are relieved by palliative measures.

Of the 13 remaining patients who have been operated upon more than once, the following 3 have been operated on, on the first and second occasion, by Dr. Cullen. One patient was operated on in 1911 at which time "marked twisting and kinking of the cystic duct" was noted. No stones were found, but the bile was "sandy" and bright yellow. The patient was perfectly well for 6 years after this operation, when she had a sudden acute gall-bladder attack. A second operation at this time revealed an acute cholecystitis. The duodenum was firmly adherent to the gall bladder and was perforated at one point during the release of these adhesions. This perforation was closed with difficulty because the tissues were so friable. No stones were found but a considerable amount of grumous material was obtained from the gall bladder. During convalescence, several small stones were expelled from the drainage tract. The patient made a rapid discovery and is well today, 5 years after her second operation. She is now 61 years of age.

The second patient was perfectly well for 2 years and then an acute empyema of the gall bladder developed. This was drained and the patient is now quite well 2 years after the second operation.

The third patient has had a definite recurrence of symptoms following the second operation.

There were three cases in which the first operation had been performed elsewhere and the second by Dr. Cullen. One of these patients had been operated on by another surgeon in 1916. Three hundred stones were found. Her symptoms returned 5 years later. Exploration at this time revealed additional stones, one of which was out in the peritoneal cavity completely walled off by omentum. Since the second operation 2 years ago the patient has been free from gall-bladder symptoms.

In a second case the cystic duct was found to be completely blocked by a large faceted stone. Since the second operation, 7 years ago, the patient has been free from symptoms except those referable to a small ventral hernia. The third patient has not been helped by the second operation.

Of the 7 remaining patients, other surgeons later removed the gall bladder from 4. We learn that 3 of these patients died soon after, before being discharged from the hospital, and the fourth patient claims that the symptoms have not been relieved by cholecystectomy. In the remaining 3 cases the gall bladder was drained. Two of these patients with gangrenous cholecystitis recovered and the third, while not well, has been markedly benefited. A summary of the 13 cases in which more than one operation has been done gives the following result:

SUMMARY OF THIRTEEN CASES OPERATED UPON MORE THAN ONCE

	Result
Three cholecystectomies	death
One cholecystectomy	not improved
Three cholecystostomies	not improved
Two cholecystostomies	improved
Four Cholecystostomies	well

Six had only medical treatment after the first operation—no subsequent operations

SUMMARY OF CASES UNIMPROVED BY THE FIRST OPERATION

A. Cases in which no subsequent operation was performed.

Case 1. Mrs. M. P. January 30, 1919. Vague abdominal symptoms with tenderness over the appendix and gall bladder. No jaundice. Appendix removed through a McBurney incision. Stones were palpated in gall bladder. Right rectus incision. Stones removed and gall bladder drained. (Note from patient 3 years later that all symptoms had returned within the past week. Relieved completely by medicine.)

Case 2. Mrs. H. H. G. June 13, 1919. Vague abdominal symptoms before operation. Cervical and perineal repair. Appendectomy and modified Gilliam suspension of uterus through mid line incision. Exploration of gall bladder revealed stones. Stones removed and gall bladder drained through right rectus incision. Abdominal symptoms have returned.

Case 3. Mrs. W. B. November 16, 1918. Appendix history. Pain at times in gall-bladder region. Large boggy appendix removed through McBurney incision. Stones found in gall bladder on palpation. Stones removed, and gall bladder drained through right rectus incision. Patient has not been benefited.

Case 4. Mrs. I. R. October 4, 1915. Repair of relaxed outlet and curettage. Myomectomy, modified Gilliam suspension of uterus and appendectomy through mid line incision. Gall bladder palpated and stones found. Stones removed and gall bladder drained through right rectus incision. Gastro-intestinal symptoms unimproved.

Case 5. Mrs. W. W. D. July 5, 1917. Vague pre-operative gastro-intestinal symptoms, suggesting a lesion of the appendix or gall bladder. Left inguinal hernia repaired. Appendix removed through a McBurney incision. Gall bladder palpated. Stones found Stones removed, one from cystic duct, and gall bladder drained. Symptoms now as before operation.

Case 6. Mrs. C. M. B. December 30, 1918. Pre-operative diagnosis of chronic appendix or chronic cholecystitis. Appendix adherent, removed through McBurney incision. Adhesions palpated about gall bladder. Gall bladder drained; no stones; adhesions released. Patient unimproved.

B. Cases in which there have been two or more operations.

Case 1. Mrs. G. E. M April 24, 1911. (First operation, by Dr. Cullen.) Definite gall-bladder symptoms. Jaundice. Pyrexia. Right rectus incision. Gall bladder enlarged, marked twisting and kinking of cystic duct. Bile bright yellow and sandy. Gall bladder drained July 12, 1917. (Second operation, by Dr. Cullen.) (Interval note: Patient well until one week ago; then an acute attack of pain in gall-bladder region. No jaundice.) Exploratory gall-bladder incision. Gall bladder firmly glued to surrounding tissue; escape of grumous material. Duodenum firmly adherent to gall bladder and perforated at one point during separation of adhesions. Almost impossible to close this rent satisfactorily because tissues were so friable. Several drains over duodenum. No stones found. Gall bladder drained. Several passed through drainage tract during convalescence. Complete recovery.

Case 2. Miss R. I. K. March 25, 1919. (First operation, by Dr. Cullen.) Appendectomy through McBurney incision. Several attacks of jaundice. Gall bladder found adherent on palpation. Gall bladder drained through right rectus incision. No stones found. March, 1921. (Second operation, by Dr. Cullen.) Acute empyema of gall bladder. Old scar excised. Gall bladder drained. Complete recovery.

Case 3. Mrs. A. C. S. April 4, 1919. (Both operations, by Dr. Cullen.) First operation 1 year ago. Recurrence of symptoms. Right rectus incision. Omentum adherent. Gall bladder distended. Stones removed and gall bladder drained. The symptoms have not been relieved by second operation.

Case 4. Mrs. W. D. June, 1916. (First operation, by another surgeon.) Three hundred gall stones removed and gall bladder drained. February 2, 1921. (Second operation, by Dr. Cullen.) Recent attacks with jaundice. Gall bladder explored, many stones found. Patient quite well since second operation.

Case 5. Mrs. S. E. April 26, 1915. First operation some years ago. (Second operation, by Dr. Cullen.) Gall bladder adherent and small. One stone lodged in cystic duct. Patient free from symptoms. Small ventral hernia.

Case 6. Mr. L. A. H. January 5, 1920. First operation 8 years ago, by another surgeon. (Second operation, by Dr. Cullen.) Gall bladder adherent. No stones found. Unimproved.

Case 7. Mrs. J. N. July 6, 1916. (First operation, by Dr. Cullen.) Acute cholecystitis. Thirty stones and a considerable amount of pus in gall bladder. Symptoms returned and second operation for gangrenous cholecystitis, by another surgeon. Patient well since second operation.

Case 8. Mrs. M. K. December 11, 1911. (First operation, by Dr. Cullen.) Gall bladder reached down to umbilicus. Walls thickened and omentum adherent. Two stones were firmly adherent in

cystic duct. (Second operation several years later, by another surgeon.) Stones of an entirely different type. Condition improved since second operation.

Case 9. Mrs. F. S. January 3, 1918. (First operation, by Dr. Cullen.) Perineal repair. Appendix removed through McBurney incision. Gall bladder found to contain stones. Stones removed and gall bladder drained through right rectus incision. Recurrence of symptoms and second operation, by another surgeon. Patient well since second operation.

Case 10. Mr. D. W. July 17, 1917. (First operation, by Dr. Cullen.) Appendix removed through McBurney incision. Stones removed from gall bladder and gall bladder drained. Patient unimproved. February 16, 1918. (Second operation, by Dr. Cullen.) Adhesions released and gall bladder drained. No stones found. Third operation, by another surgeon. Cholecystectomy attempted. Death 10 days after operation.

Case 11. Mr. R. G. January 1910. (First operation, by Dr. Cullen.) A very fat man. Gall bladder distended, full of grumous material. Two small stones. Improved. Several years after symptoms returned. Cholecystectomy, by another surgeon. Death a few days later.

Case 12. Mrs. F. B. D. June 13, 1904. (First operation, by Dr. Cullen.) Small gall bladder, containing 20 stones. Cystic duct 2 centimeters in diameter, plugged with small stones. Hepatic duct plugged with stones 1 centimeter in diameter. Drain left in hepatic duct. Second operation in February, 1921, by another surgeon. Gall bladder removed. Death after this operation.

Case 13. Mrs. E. C. S. December 10, 1909. (First operation, by Dr. Cullen.) Seventy-five cubic centimeters of pus and 20 stones. Several stones in cystic duct. Patient unimproved. In June, 1921, second operation, by another surgeon. Cholecystectomy. Unimproved.

SUMMARY OF CASES MARKEDLY IMPROVED BY DRAINAGE OF THE GALL BLADDER

The following cases show that the patients have been much improved by the operation. Some occasionally have had abdominal distention or constipation. Others show some tenderness in the gall-bladder region. A few have had arthritis or neuritis and one has had jaundice without pain.

All of these patients seem to have been much better since the drainage of the gall bladder.

Case 1. Mrs. McN. May 25, 1902. Symptoms for several years. Gall bladder adherent, large stone removed. Drainage tract remained open over 6 months. Incision became infected. Later the patient recovered completely and has had no return of symptoms for 17 years.

Case 2. Mrs. R. G. May 3, 1907. Gall bladder colic for 3 months. Skin at time of operation bronze-colored. Gall bladder wall thickened and œdematous. Gall bladder and cystic duct filled with thick tarry material. Normal bile escaped after this was removed. The patient has had only one recurrent attack. This occurred about 1 year ago, and was relieved by palliative measures. No other attacks since.

Case 3. Mrs. K. M. M. February 4, 1908. Chronic cholecystitis. Appendix removed. Fifty stones removed from gall bladder. Marked visceroptosis noted at operation. Recently she has been having gastro-intestinal upsets, intermittent attacks of diarrhœa and meteorism, with no localizing symptoms.

Case 4. Mrs. S. C. April, 1908. Appendectomy. Fifty stones removed from gall bladder. She has a small ventral hernia which causes no symptoms. Developed multiple arthritic lesions 5 years ago.

Case 5. Mrs. J. H. January 11, 1912. Typhoid fever at 15. Gall-bladder symptoms since then. Appendectomy. Fifteen stones removed from gall bladder. Her physician states that he is treating her for neuritis and "auto-intoxication." She is also receiving radium therapy for uterine malignancy.

Case 6. Mrs. V. M. November 15, 1912. Symptoms for 12 years. Stones removed. Her physician states that patient is perfectly well, "fat as a pig." Slight recurrence of gall-bladder pain 1 year ago. No trouble since then.

Case 7. Mrs. L. J. May 29, 1913. Stones removed. Her physician states that at times there is a great deal of pain and soreness in the gall-bladder region. Attacks are never severe.

Case 8. Mrs. F. S. June 27, 1913. Symptoms for many years. Acute attack at time of operation. Stones removed from gall bladder and cystic duct. Common duct seemed quite indurated on palpation. She feels quite well when on a restricted diet. Being treated for neuritis at present time.

Case 9. Mrs. J. N. H. May 23, 1914. Typical gall-stone attacks. Typhoid fever 10 years ago. Recent attacks accompanied by jaundice and clay-colored stools. Stones removed. She was well until 18 months ago. A few attacks of cramp-like epigastric pain in past 18 months. Not severe. Attacks relieved by palliative measures.

Case 10. Mrs. N. L. March 11, 1915. Chronic cholecystitis. Appendectomy. Many stones and a considerable amount of putty-like material removed from gall bladder. She has had a few recurrent attacks recently. "Completely cured by 58 chiropractic treatments."

Case 11. Mrs. M. J. March 16, 1916. Symptoms for years. Stones removed from gall bladder and cystic duct. No return of pre-operative symptoms, but she suffers from chronic constipation.

Case 12. Miss M. E. May 26, 1919. Hysteromyomectomy and appendectomy through a mid-line incision. Gall-bladder drained through right rectus incision. Fifty cubic centimeters of putty-like

material and several stones removed. Gall-bladder wall quite thickened and friable. No recurrence of symptoms except flatulence. Health quite good.

CASE 13. Miss R. H. January 6, 1916. Typhoid fever 10 years ago. Several typical gall-bladder attacks in past 6 months. One large ball-valve stone removed. Two years ago she had a slight attack of gall-bladder pain lasting 1 day. No other attacks. Perfectly well at present.

CASE 14. Mrs. A. H. S. January 1917. Adhesions about gall bladder released. No stones. Gall bladder drained. The patient is perfectly well except for occasional slight discomfort along the right costal margin.

CASE 15. Miss O. B. June 16, 1917. Typical attacks. Appendectomy. Three hundred stones removed. "Two or three spells that I was afraid were attacks of gall stones but were not severe enough to call a doctor."

CASE 16. Mrs. E. M. U. October 15, 1917. Frequent typical gall-bladder attacks. Appendectomy. Release of adhesions about gall bladder. No stones. Gall bladder drained. No recurrence of pain. Frequent attacks of "gas accumulation."

CASE 17. Mrs. S. J. J. February 28, 1918. Midline ventral hernia following urinary bladder operation. Hernial sac resected. Gall stones removed. Much improved. Once in a while experiences sudden sharp pain in region of right costal margin.

CASE 18. Mr. N. S. W. July 9, 1917. Typical symptoms for 20 years. Appendectomy. Thirty stones removed. The patient feels perfectly well, with the exception of occasional slight attacks of jaundice without pain or any other manifestations.

CASE 19. Miss C. M. F. March 21, 1918. Appendectomy. Release of adhesions about gall bladder. No stones. Gall bladder drained. In May, 1920, she was confined to bed for 2 weeks. Symptoms as before operation but much less severe. She was quite neurotic until married in August, 1920. Since then has gained 38 pounds and has had no symptoms.

CASE 20. Mrs. G. O. December 10, 1918. Appendectomy. Stones removed from gall bladder. Symptoms as before operation, but much less severe.

CASE 21. Mrs. C. H. T. May 5, 1919. Appendectomy. Marked ptosis of liver. Stones removed from gall bladder. The patient states that except for frequent attacks of distention she is perfectly well.

CASE 22. Mrs. J. A. B. March 10, 1919. Appendectomy. Stones removed from gall bladder. Gall-bladder wall friable; about 50 cubic centimeters of pus obtained. Recurrent attacks since operation, but much less severe and of shorter duration.

CASE 23. Mrs. J. C. M. March 3, 1919. Appendectomy and modified Gilliam suspension of uterus. Stones removed from gall bladder. A good deal of indigestion since operation.

CASE 24. Mrs. J. D. February 11, 1919. Appendectomy and modified Gilliam suspension. Forty stones removed from gall bladder and a large amount of putty-like material. Several attacks since May, 1921, but not so long nor so severe as before operation.

CASE 25. Mrs. G. F. M. December 21, 1920. Adhesions released about gall bladder; no stones. Gall bladder drained. She still has indigestion, but has been much improved by operation.

CASE 26. Mrs. A. S. October 18, 1919. Appendectomy. Typical gall-bladder symptoms for years. Fifty stones removed. Fell 1 week after return home and wound reopened, discharging freely for 2 weeks. Severe pain in region of gall bladder for several months. Doing well now. Does all her house work at present.

SUMMARY OF PATIENTS LIVING AND WELL AFTER DRAINAGE OF THE GALL BLADDER

In order that the reader may gain a clear idea of just how long the patients have remained well since operation, I have for convenience grouped them as follows:

	Acute	Chronic	Exploratory during other operations	Total
Those well 1 to 3 years after operation	22	20	0	42
Those well 3 to 5 years after operation	14	22	6	42
Those well 5 to 10 years after operation	14	25	7	46
Those well over 10 years after operation	15	20	3	38
Death from other causes; no return of gall-bladder symptoms (see table)	18	13	3	34
	83	100	19	202

1. Patients Living and Well, One to Three Years After Operation

CASE 1. Mrs. G. W. McC. February 6, 1919. Gastro-intestinal upsets. No jaundice. Perineal repair. Appendectomy. Right rectus incision. Gall bladder slightly adherent, tarry bile would not flow through trocar. Fifty small stones removed.

CASE 2. Miss E. McC. October 13, 1919. Gall bladder and appendix history. Right rectus incision. Appendix adherent. Removed. Six stones removed.

CASE 3. Mrs. S. E. D. April 8, 1919. The patient had given birth to a full-term baby 6 weeks before. Pain in gall-bladder region and right shoulder. Patient acutely ill. Gall bladder long and small, free from adhesions; some small stones removed.

CASE 4. Miss A. G. November 17, 1919. Jaundice at times. Appendectomy. Gall bladder thickened near its tip, felt almost like new-growth; wedge removed from fundus of gall bladder; 12 small stones removed.

Case 5. Mrs. E. B. H. November 4, 1919. Appendectomy 10 or 12 years ago. Definite gall-bladder attacks. Pelvic examination reveals definite adenomyoma. Right rectus incision. Small stones and two large conglomerate masses; also some stones down in cystic duct.

Case 6. Mrs. W. F. F. May 19, 1919. Cervical and perineal repair. Definite gall-bladder symptoms. Mid-line incision. Appendectomy. Modified Gilliam suspension. Right rectus incision. One conglomerate mass of 20 stones. Stones removed.

Case 7. Mrs. F. H. March 10, 1920. Gall-bladder symptoms. Right rectus incision. Walls 3 millimeters thick. Stone in cystic duct, removed with difficulty.

Case 8. Mrs. C. R. P. October 23, 1920. Gall-bladder symptoms. Gall bladder palpable and tender. Right rectus incision. Fat indurated. Abscess with 40 cubic centimeters of pus, rather grumous and sticky, just under peritoneum.

Case 9. Mrs. A. December 6, 1920. Many gall-bladder attacks. Gridiron incision. Appendix adherent, free fluid. Appendectomy. Right rectus incision. Gall-bladder walls 3 to 5 millimeters thick and very friable. One hundred cubic centimeters of pus. Stones removed, one wedged in cystic duct.

Case 10. Mr. F. H. K. May 13, 1919. Gridiron incision. Appendix thickened and adherent. Appendectomy. Right rectus incision. Stones removed; stone in cystic duct; to dislodge these it was necessary to slit gall bladder down to duct.

Case 11. M. W. H. March 25, 1919. Indigestion. White blood cells 22,000. Temperature 101°. Gridiron incision. Free milky fluid. Appendix twice normal size. Removed. Right rectus incision. Gall bladder distended, yellowish green and mottled due to commencing gangrene. One stone in cystic duct.

Case 12. Mrs. J. A. J. April 3, 1920. Appendix and gall-bladder symptoms. Appendectomy with difficulty. Few small gall stones and one 2 centimeters in diameter embedded in cystic duct.

Case 13. Mrs. D. S. February 26, 1919. Appendix and gall-bladder symptoms. McBurney incision. Appendectomy. Right rectus incision. Gall bladder adherent, covered with lymph. Much pus present. Stone embedded in cystic duct.

Case 14. Mr. W. E. W. October 29, 1919. Temperature 101°. White blood cells 21,000. Moderate abdominal distention. Gridiron incision. Atrophic appendix removed. Right rectus incision. Liver 4 inches below costal margin and gall bladder far in under the liver. Œdema of surrounding tissue. Four or five yellowish-green patches of gangrene on gall-bladder wall. One irregular stone removed. Cystic duct thickened, but contained no stones.

Case 15. Mr. C. P. March 25, 1920. Acute cholecystitis. White blood cells 21,600. Right rectus incision. Two hundred cubic centimeters of turbid fluid. Gall bladder friable. Much pus. Stones removed.

Case 16. Mr. J. K. June 7, 1920. Large gall bladder. Omentum adherent. Suspensory ligament cut. Gall bladder liberated. Many small stones; one 1.5 centimeters in diameter; several in cystic duct.

Case 17. Mrs. J. A. June 14, 1920. White blood cells 9,000. Gall-bladder symptoms. Right rectus incision. Liver enlarged, peritoneum thickened. Œdematous tissue about gall bladder. Gall-bladder wall 3 to 4 millimeters thick. Greenish area at one point where gall bladder was perforated. One stone 2 centimeters long removed.

Case 18. Mrs. H. A. G. January 18, 1921. Gall-bladder attacks for 5 years. Gridiron incision. Appendectomy. Right rectus incision. Gall bladder small and normal. Sixty dark grayish-black stones removed.

Case 19. M. T. March 21, 1921. Diabetes. Sore throat (hæmolytic streptococcus). Umbilical hernia. Myomata uteri. Mid-line incision. Hysteromyomectomy and appendectomy. Repair of umbilical hernia. Right rectus incision. Forty stones removed.

Case 20. Mrs. E. S. March 10, 1921. Gall-bladder and appendix symptoms. Gridiron incision. Retrocæcal appendix, adherent and enlarged. Appendectomy. Right rectus incision. Sixty stones; putty-like material. Gall-bladder walls thick.

Case 21. Mrs. W. L. October 13, 1920. Jaundice. Gall-bladder symptoms. Gridiron incision. Appendectomy. Right rectus incision. Stones removed.

Case 22. Mrs. A. R. M. November 6, 1920. Typhoid fever several years before. Cardiorenal history. Signs of obstruction. Gall-bladder symptoms. Acute attack at present. Right rectus incision. (Local anæsthesia.) Four hundred cubic centimeters of pus. No stones.

Case 23. Mrs. J. H. September 15, 1920. Gall-bladder symptoms. Shadow in gall-bladder region on X-ray plate. Gridiron incision. Appendix normal, removed. Right rectus incision. Stone surrounded by putty-like material. Conglomerate stone down in cystic duct.

Case 24. Mrs. C. H. C. March 16, 1920. Gall-bladder and appendix symptoms for years. Gridiron incision. Appendectomy. Right rectus incision. Forty-two triangular-shaped gall stones.

Case 25. Mrs. H. R. April 1, 1920. Gall-bladder and appendix symptoms. Gridiron incision. Appendix injected. Appendectomy. Right rectus incision. Eighty stones removed. None in ducts.

Case 26. Mrs. G. K. July 11, 1919. Ill 1 month with gall-bladder pain. Appendix normal. Cæcum adherent. Adhesions released. Appendectomy. Right rectus incision. Gall bladder constricted by adhesions. Gall bladder adherent to omentum and duodenum. No stones.

Case 27. Mr. T. P. February 1, 1919. Gastro-intestinal symptoms. Stones diagnosed from X-ray plate. Gridiron incision. Appendix adherent.

Appendectomy. Right rectus incision. Liver smaller than normal. Gall bladder full of stones lying 6 inches beneath surface of liver and transversely. A most difficult gall bladder to expose. Several hundred shot-like stones removed. Some down in cystic duct.

Case 28. Miss N. R. June 21, 1920. Appendix and gall-bladder symptoms. Gridiron incision. Appendectomy. Right rectus incision. Gall bladder small, thick-walled; milky tenacious fluid with mulberry shaped stones. One in cystic duct had to be broken up before removal.

Case 29. Mrs. J. B. E. March 31, 1919. The patient had given birth to a full-term child 2 weeks before. Several acute gall-bladder attacks without fever. Right rectus incision. Yellowish serous fluid in peritoneal cavity. Acute pancreatitis. Gall bladder of normal size, not adherent. Forty stones removed. A few stones were found in cystic duct.

Case 30. Mrs. J. E. N. October 6, 1919. No jaundice. Indigestion. Temperature normal. White blood cells 15,000. Appendix contained concretions. Appendectomy. Much œdema in tissues about gall bladder and duodenum. Fifty triangular stones removed.

Case 31. Mrs. O. S. January 2, 1919. History of gall-bladder attacks with jaundice. Gridiron incision. Tip of appendix adherent and thickened. Right rectus incision. Stones removed.

Case 32. Mrs. G. R. January 4, 1919. Several gall-bladder attacks. Gridiron incision. Appendix enlarged. Appendectomy. Right rectus incision. Gall bladder 7 inches long, adherent to omentum. Eight stones removed.

Case 33. Mrs. C. B. December 6, 1920. Gall-bladder and appendix symptoms. McBurney incision. Appendix adherent. Very friable; broke off at base. Right rectus incision. Ten stones removed, 4 in cystic duct.

Case 34. Mrs. M. C. June, 1920. Jaundice. Right rectus incision. Gall bladder not enlarged. Twenty cubic centimeters of gelatinous, tarry material with minute stones. Stone about 3 centimeters in diameter down at cystic duct.

Case 35. Mrs. H. L. May 19, 1919. Gall-bladder attacks with jaundice. Gridiron incision. Appendix thickened and cæcum adherent. Right rectus incision. Pancreas thickened; twice the normal size and nodular. One conglomerate stone in gall bladder. Gall bladder not thickened.

Case 36. Mr. J. W. H. October 16, 1920. Sudden and marked jaundice. Right rectus incision. Markedly adherent. Gall bladder small and contracted. Cystic duct thickened. No stones made out, but inflammatory condition obstructing the common duct.

Case 37. Mrs. F. McL. March 31, 1920. A very stout woman. Definite gall-bladder history. Gridiron incision. Appendix enlarged and adherent. Appendectomy. Right rectus incision. One stone removed.

Case 38. Mrs. J. B. March 29, 1920. No jaundice. Rheumatic spine. Gridiron incision. Appendix normal. Appendectomy. Right rectus incision. Gall bladder packed with stones. Stones removed.

Case 39. Mr. T. L. R. December 13, 1920. Gall-bladder symptoms at present. Similar attack 30 years ago. Gall bladder large and contained black stones resembling cinders. Stones removed from gall bladder and cystic duct.

Case 40. Mrs. O. April 7, 1919. Jaundice for a few days and discomfort in gall-bladder region. Right rectus incision. Gall bladder distended but free from adhesions. Fifty stones removed. Many down in cystic duct.

Case 41. Miss D. M. H. February 2, 1920. Several gall-stone attacks and slight jaundice at present. Very stout woman. Right rectus incision. One stone removed.

Case 42. Mrs. J. G. K. June 1, 1920. Mid-line incision. Appendectomy. Modified Gilliam suspension. Right rectus incision. One stone removed.

2. Patients Living and Well, Three to Five Years After Operation

Case 1. Mrs. J. W. D. April 8, 1918. Appendix and gall-bladder history. McBurney incision. Appendix adherent. Appendectomy. Right rectus incision. Six large stones and many small ones. Gall bladder adherent.

Case 2. Mrs. W. Z. February 13, 1918. Gall-bladder symptoms since labor in August, 1916. Median incision. Modified Gilliam suspension. Appendectomy. Right rectus incision. Forty stones removed.

Case 3. Mrs. M. G. February 8, 1917. History of jaundice. Soreness at right costal margin. Some tenderness over McBurney's point. McBurney incision. Appendix tied down in middle portion. Right rectus incision. One conglomerate stone made up of numerous small ones. Removed.

Case 4. Mrs. J. H. P. July 12, 1918. Gall-bladder symptoms with jaundice. Mid-line incision. Myomectomy. Appendix adherent—removed. Right rectus incision. Gall bladder enlarged; contained bile and stones. Stones removed.

Case 5. Mrs. F. W. P. February 22, 1918. Several gall-stone attacks, never jaundiced. Repair of relaxed vaginal outlet. Gridiron incision. Appendectomy. Right rectus incision. Three stones removed.

Case 6. Miss A. L. May, 1918. She had had gall-bladder symptoms for 2 years. Very fat. Appendix enlarged and distended. Appendectomy. Right rectus incision. Six stones, one in cystic duct crushed during attempts to remove it.

Case 7. Mrs. B. G. March 27, 1918. Appendix normal. Appendectomy. Gall bladder contained one irregular stone, 1.5 centimeters long, and some smaller ones. Gall bladder drained.

Case 8. Mrs. N. T. W. June, 1917. Pain along right costal margin and marked jaundice. White

blood cells 19,000. Gridiron incision. Appendix small and tied up under the liver. Right rectus incision. Tip of appendix removed from under surface of liver. Gall bladder very adherent. Golden yellow mucoid material but no definite stones.

Case 9. Miss I. C. October 22, 1916. Acute gall-bladder pain. Ruptured duodenal ulcer suggested. Jaundice a little later. Right rectus incision. Gall bladder and omentum adherent. Stones removed from gall bladder; one blocking cystic duct. Pancreas thickened, with sharp edge. Duodenum not opened.

Case 10. Mrs. J. O. B. January 9, 1917. Gridiron incision. Omentum adherent. Appendectomy. Right rectus incision. Many triangular stones. Gall-bladder walls whitish yellow. Small calcareous body at junction of cystic and common duct which could not be loosened.

Case 11. Mrs. H. B. M. April 7, 1917. Mid-line incision. Uterus one and a half times the normal size and very firm. Supravaginal hysterectomy. Bilateral salpingo-oophorectomy. Appendix, retrocæcal and adherent. Appendectomy. Right rectus incision. Gall bladder small and free from adhesions. Stone 8 millimeters in diameter, acting as a ball-valve.

Case 12. Mrs. M. K. March 15, 1917. Pain down right side, more marked over gall bladder. Gridiron incision. Appendix twice normal size. No adhesions. Right rectus incision. Gall bladder free from adhesions. Several hundred stones, one densely adherent in cystic duct.

Case 13. Mrs. T. F. D. October 31, 1917. Gall-bladder symptoms for past 3 or 4 years. Gridiron incision. Omentum adherent. Appendectomy. Right rectus incision. Adhesions about cystic duct, only. Cystic duct filled with stones and markedly thickened. Upper part of gall bladder removed.

Case 14. Mrs. G. F. June 21, 1918. Pain over appendix and gall bladder. No signs of pregnancy. Dilatation and curettage. Repair of relaxed vaginal outlet. Gridiron incision. Appendectomy. Right rectus incision. Gall bladder filled with stones. Stones removed, one from cystic duct.

Case 15. Mrs. E. P. April 22, 1918. History of gall-bladder lesion. Right rectus incision. Appendix full of hard concretions; adherent and lay up in region of liver. Gall bladder strawberry type but contained no stones. Lymph gland 1 centimeter long on either side of common duct, which probably accounted for intermittent jaundice.

Case 16. Mrs. H. G. D. September 26, 1917. Gall-bladder symptoms. Excruciating pain in past 24 hours. Gridiron incision. Appendix one and a half times normal size and adherent. Appendectomy. Right rectus incision. Sixty stones removed.

Case 17. Mr. J. H. October 18, 1918. Several gall-bladder attacks. Right rectus incision. Gall bladder smooth, free from adhesions, but very tense. Five stones removed.

Case 18. Mrs. V. M. March 27, 1918. Definite gall-bladder history. Jaundice several weeks ago. Appendix operation 2 years ago. Postoperative hernia. Repair of hernia. Right rectus incision. Gall bladder small and adherent. No stones.

Case 19. Miss H. McM. October 16, 1917. Appendectomy several years ago. Frequent acute gall-bladder attacks. Right rectus incision. Gall bladder adherent to duodenum, cæcum, and ascending colon. Gall bladder strawberry type. Stones removed.

Case 20. Mrs. J. G. April 12, 1918. Gall-bladder symptoms for 13 years. Gridiron incision. Appendectomy. Right rectus incision. Dense gall-bladder adhesions released. Many stones removed.

Case 21. Miss H. R. July 16, 1918. Typical gall bladder and appendix history. Gridiron incision. Velvety adhesions about appendix. Appendix removed. Right rectus incision. Stones removed.

Case 22. Mrs. G. B. W. October 26, 1916. Gall-bladder symptoms for 18 months. Occasional jaundice. Gridiron incision. Appendectomy. Right rectus incision. Stones removed.

Case 23. Mrs. G. K. March 15, 1918. Definite gall-bladder history. Gridiron incision. Appendectomy. Right rectus incision. One large stone removed.

Case 24. Mrs. J. F. McC. June 27, 1918. Several mild gall-bladder attacks with jaundice. Gridiron incision. Appendectomy. Right rectus incision. Gall bladder adherent. Stones removed from gall bladder and cystic duct.

Case 25. Mrs. H. January 16, 1918. Appendectomy several years ago. Indefinite gall-bladder history. X-ray plate showed 13 small stones. Right rectus incision. Gall bladder adherent. Thirteen stones removed.

Case 26. Mrs. W. F. December 6, 1916. Gall-bladder symptoms. Gall bladder fills greater part of right abdomen. Right rectus incision. Tremendously long gall bladder. Stood up 6 inches from abdominal wall. Three hundred cubic centimeters of grumous brownish material, containing cholesterin crystals. Stone in cystic duct. Gall-bladder wall thickened and indurated. Excess of gall-bladder wall removed.

Case 27. Mrs. M. December 10, 1918. Consultant felt there was an appendix and also a gall-bladder lesion. Repair of relaxed vaginal outlet. Median incision. Appendix removed. Modified Gilliam suspension of uterus. Right rectus incision. Gall bladder adherent.

Case 28. Mrs. V. D. H. October 1917. No typhoid. Several gall-bladder attacks with jaundice. Right rectus incision. No adhesions. Stones removed.

Case 29. Dr. A. C. H. October 7, 1917. Appendectomy 1 year ago. Symptoms not relieved. Typical gall-bladder attacks. Right rectus incision. Stones removed. Some in cystic duct. Gall-bladder wall very friable and markedly indurated. Since this tabulation was made patient has had several digestive attacks.

Case 30. Dr. C. G. July 3, 1917. Appendix and gall-bladder history. Gridiron incision. Adhesions. Appendectomy. Right rectus incision. Gall bladder adherent. Stones removed.

Case 31. Mr. F. P. B. July 22, 1918. Typical gall-bladder symptoms. Right rectus incision. Stones removed. Appendectomy.

Case 32. Mrs. L. H. February 16, 1918. Gall-bladder and appendix history. Gridiron incision. Appendix injected. Removed. Right rectus incision. Gall bladder adherent. Stones removed.

Case 33. Mrs. J. E. G. November 7, 1917. Appendix and gall-bladder symptoms. Gridiron incision. Appendectomy. Right rectus incision. Gall bladder adherent. Walls thickened and indurated. Stones and part of gall bladder removed.

Case 34. Mrs. A. N. March 27, 1918. Gall-bladder symptoms. Gridiron incision. Appendectomy. Right rectus incision. Gall bladder adherent, friable and œdematous. Stones removed.

Case 35. Mrs. J. M. April 7, 1917. Marked relaxed vaginal outlet. History of gall stones. Right rectus incision. Appendectomy. Stones removed. Repair of relaxed vaginal outlet.

Case 36. Miss E. L. June 18, 1917. History of mitral disease following rheumatism. Tonsils burned out. Acute gall-bladder symptoms at present time. Gridiron incision. Appendix removed. Right rectus incision. Gall bladder filled with putty-like material.

Case 37. Mrs. A. D. C. February 29, 1918. Gall-bladder history. Gridiron incision. Appendix adherent, removed. Right rectus incision. Gall-bladder adherent. Stones removed. Several in cystic duct.

Case 38. Mrs. L. H. January 19, 1918. Gall-bladder symptoms. Right rectus incision. Gall bladder adherent. Walls thickened and indurated. Stones removed.

Case 39. Mrs. M. M. W. November 22, 1917. Ovarian cyst with twisted pedicle. Temperature 101°. White blood cells 18,000. Median incision. Left ovarian cyst removed. Right rectus incision. Stones removed.

Case 40. Mrs. B. S. March 3, 1917. Gall-bladder symptoms for 8 years. Right rectus incision. Gall bladder adherent. Adhesions easily liberated. Quantity of grayish fluid. Stones removed.

Case 41. Mrs. H. G. C. July 25, 1918. Left ovarian cyst. Median incision. Ruptured multilocular ovarian cyst removed. Appendix removed. Right rectus incision. Stones removed. Small amount of pus in gall bladder.

Case 42. Mrs. W. C. B. March, 1918. Typhoid six years ago. Jaundiced at present and gall-bladder symptoms. Gall-bladder adhesions. Drained No stones.

3. Patients Living and Well, Five to Ten Years After Operation

Case 1. Mrs. I. B. June 19, 1916. Gall-bladder and appendix history. Myomata uteri. Gridiron incision. Appendix removed. Right rectus incision. Gall stones removed.

Case 2. Mrs. T. R. H. May 2, 1914. Definite symptoms. Gall bladder palpable, quite tender, extends down to umbilicus. Right rectus incision. Gall bladder adherent. Large amount of pus. Stones removed.

Case 3. Mrs. F. A. September 10, 1914. Pelvic operation by Dr. Kelly 18 years ago. Gall-bladder symptoms for past year. Right rectus incision. Three hundred cubic centimeters of pus. Stones removed. She is now 70 years old, has an arthritic lesion of the right knee and ankle.

Case 4. Mrs. M. C. March 15, 1913. Gall-bladder symptoms. Right rectus incision. Appendectomy. Gall bladder large and thick-walled. Stones removed.

Case 5. Mrs. B. O. October 23, 1912. Gall-bladder symptoms for 6 years. Right rectus incision. Gall-bladder wall dense and friable. Stones removed.

Case 6. Mrs. E. P. March 17, 1913. Gall-bladder symptoms. Mid-line incision. Modified Gilliam suspension of uterus. Appendectomy. Right rectus incision. Gall bladder adherent. One stone removed.

Case 7. Mrs. C. M. February 27, 1915. Definite gall-bladder history. Right rectus incision. Gangrenous patches visible over wall of gall bladder. Walls friable and very thick.

Case 8. Mrs. F. H. February 1915. Median incision. Hysteromyomectomy. Appendectomy. Gall stones not suspected before operation. Right rectus incison. Stones removed.

Case 9. Mrs. E. S. November 9, 1912. Typical symptoms with jaundice. Right rectus incision. Gall bladder adherent. Large stone in cystic duct, removed with difficulty.

Case 10. Mrs. C. L. February 29, 1912. Gall-bladder symptoms for 5 years. Right rectus incision. Appendix removed. Gall bladder adherent. Considerable pus. Stones removed.

Case 11. Mrs. C. S. S. June 15, 1912. Frequent attacks with jaundice. Right rectus incision. Appendix adherent. Removed. Gall bladder adherent. Stones removed from gall bladder and cystic duct.

Case 12. Mrs. J. P. G. March 13, 1916. Frequent typical gall-bladder attacks. Complete prolapsus of uterus. Amputation of cervix. Vaginal fixation of uterus. Repair of relaxed vaginal outlet. Right rectus incision. Many stones removed. One from cystic duct.

Case 13. Mrs. C. H. A. April 21, 1913. Typical attacks in past year. Median incision. Uterus and adnexa normal. Atrophic appendix removed. Right rectus incision. Gall bladder adherent. Fifty stones removed. Several stones encapsulated outside of gall bladder.

Case 14. Mrs. F. M. M. March 26, 1913. Typical symptoms with jaundice. Uterus in retroposition. Median incision. Modified Gilliam sus-

pension of uterus. Appendectomy. Right rectus incision. Gall stones removed.

Case 15. Mr. O. M. November 2, 1914. Very fat man. Acute attack at present. Temperature 101°. White blood cells 15,000. Right rectus incision. Much pus and many small stones removed.

Case 16. Mr. H. C. S. October 19, 1916. Typhoid fever 20 years ago. Gall-bladder attacks for past 6 years. Loss of 45 pounds in past 3 years. White blood cells 13,000. Right rectus incision. Gall bladder adherent. Two hundred stones. Gall bladder lay transversely; cystic duct coming off at right angles. Many stones in cystic duct.

Case 17. Mrs. J. B. W. May 27, 1916. Gall-bladder symptoms for 18 years. Right rectus incision. Gall bladder distended. Many stones removed.

Case 18. Mrs. W. L. November 12, 1915. Acute cholecystitis. Onset 48 hours before. Temperature 104 . Right rectus incision. Gall bladder adherent. Gangrenous area. Stones removed.

Case 19. Mrs. P. July 3, 1914. Gall-bladder lesion not suspected before operation. Uterus enlarged and adherent. Adnexa glued down in pelvis Mid-line incision. Hysterectomy. Bilateral salpingo-oophorectomy. Appendectomy. Right rectus incision. Stones removed.

Case 20. Mrs. H. A. June 21, 1913. Definite gall-bladder history. Stones have been found in stools after attacks. Right rectus incision. Gall bladder distended, walls friable. One hundred and fifty cubic centimeters of pus. Many stones removed, some from cystic duct.

Case 21. Mrs. T. C. May 17, 1913. Typical gall-bladder symptoms. Right rectus incision. Appendix small and adherent. Appendectomy. Gall bladder adherent. Stones removed.

Case 22. Mrs. J. E. B. May 5, 1913. Typical gall-bladder symptoms. Right rectus incision. Appendix atrophic. Appendectomy. Gall bladder quite adherent and full of stones.

Case 23. Mrs. H. D. M. November 5, 1912. Typical gall-bladder symptoms, with jaundice and recent loss of weight. Right rectus incision. Gall bladder adherent, distended; 20 stones removed, about 75 cubic centimeters of pus present.

Case 24. Mrs. B. E. B. June 4, 1913. Curettage for irregular bleeding. Definite history of appendicitis and gall-bladder lesion. There has been jaundice during many attacks. Right rectus incision. Appendectomy, many stones removed from the gall bladder.

Case 25. Mrs. W. L. F. May 23, 1912. Gall-bladder symptoms for past 10 years. Right rectus incision. Appendix adherent, appendectomy. Gall bladder adherent; many stones and a large amount of putty-like material removed.

Case 26. Mrs. L. G. November 1912. Typical symptoms for many months. Gall bladder easily palpated. Right rectus incision. Gall-bladder wall thickened and adherent; many stones removed.

Case 27. Mrs. F. W. V. February 7, 1913. Typical symptoms for 9 months. Right rectus incision. Seven stones removed.

Case 28. Mrs. A. K. September 16, 1916. Definite gall-bladder symptoms. X-ray plates negative. Right rectus incision. Gall-bladder wall thickened. Many stones removed. Cystic duct thickened.

Case 29. Mrs. J. E. H. May 25, 1916. Very stout woman. Typical gall-bladder symptoms. Right rectus incision. Gall bladder adherent. Several stones removed; one from cystic duct. Small amount of pus present.

Case 30. Mrs. H. S. H. March 18, 1915. Preoperative diagnosis not made. Operation undertaken for removal of fibroids. Mid-line incision, hysteromyomectomy, left salpingo-oophorectomy and appendectomy. Right rectus incision; 4 stones removed.

Case 31. Mrs. G. A. July 6, 1916. Definite gall-bladder and appendix history. Gridiron incision. Appendix injected and adherent. Appendectomy. Right rectus incision, many stones removed.

Case 32. Mrs. L. M. October 14, 1914. Preoperative diagnosis of appendix or gall-bladder lesion. Repair of relaxed vaginal outlet. Hæmorrhoidectomy. Right rectus incision. Retrocæcal appendix. Appendectomy. Gall stones removed.

Case 33. Mrs. J. C. June 15, 1912. Gall-bladder symptoms for the past year. Right rectus incision. Gall bladder adherent. One large stone removed.

Case 34. Mrs. G. A. A. December 7, 1914. Typical gall-bladder attacks. Right rectus incision. Twenty stones removed from gall bladder; 1 stone encysted in cystic duct. Small amount of pus present.

Case 35. Dr. J. H. P. October 5, 1916. Onset 6 days ago with symptoms suggesting intestinal obstruction; chills. White blood cells 14,000. Preoperative diagnosis; empyema of gall bladder. Right rectus incision. Gall bladder adherent, walls thickened, anterior wall gangrenous. One hundred cubic centimeters of pus present and about 20 stones.

Case 36. Mrs. L. McP. September 14, 1914. Acute symptoms in past 24 hours. Temperature 101°. White blood cells 16,000. Right rectus incision. Gall-bladder walls gangrenous, ruptured at one point. Large amount of pus removed; one small stone found in cystic duct.

Case 37. Mrs. H. V. January 16, 1913. Gastroenterostomy several years ago, release of adhesions after this operation, resection of ascending and portion of transverse colon with lateral anastomosis of ileum to transverse colon. (These operations by other surgeons some years before present admission.) Right rectus incision. Gall bladder densely adherent and thick walled. No stones found.

Case 38. Mrs. O. F. January 4, 1915. Typhoid fever 30 years ago. Frequent gall-bladder attacks since then, occasionally accompanied by jaundice.

Right rectus incision. Gall bladder adherent; 30 stones removed.

Case 39. Mrs. M. E. B. October 20, 1915. Appendix and gall-bladder symptoms. Gridiron incision, appendectomy. Right rectus incision. Gall-bladder wall thickened, with definite gangrenous areas. One hundred cubic centimeters of pus. Stone measuring 1 by 3 inches removed—the largest I have ever seen.

Case 40. Miss L. E. September 22, 1913. Typical gall-bladder symptoms, with acute exacerbation at present. Right rectus incision. One hundred stones removed and large amount of pus.

Case 41. Mrs. M. N. November 23, 1913. Typical gall-bladder symptoms, with exacerbation at present. Temperature 101°. White blood cells 16,000. Right rectus incision. Large amount of pus present. Three stones removed, one from cystic duct.

Case 42. Mrs. C. H. L. February 15, 1916. Definite history of diabetes, which is completely controlled by diet. Operation undertaken for gynecological condition. Gall-bladder lesion not diagnosed before operation. Perineal operation, trachelorrhaphy; anterior and posterior colporrhaphy. Mid-line incision. Hysterectomy and appendectomy. Right rectus incision; three small stones removed.

Case 43. Mrs. C. F. L. November 13, 1916. The patient has a definite infectious arthritis. Tonsillectomy; and numerous teeth have been extracted as possible foci of infection. Condition not relieved. Operation for repair of cervix and repair of relaxed vaginal outlet. Mid-line incision. Modified Gilliam suspension of the uterus. Appendix adherent; appendectomy. Right rectus incision. Six stones removed. The arthritic condition completely disappeared within a few weeks after operation.

Case 44. Mrs. D. C. D. November 19, 1914. Mid-line incision for huge multilocular ovarian cyst. Right rectus incision. Gall bladder adherent. Stone removed from cystic duct.

Case 45. Mrs. R. H. February 19, 1913. Typical gall-bladder symptoms. Marked laceration of the cervix, relaxation of the vaginal outlet and retroposition of the uterus. Amputation of cervix and repair of relaxed vaginal outlet. Mid-line incision. Modified Gilliam suspension of the uterus. Appendectomy. Right rectus incision. Many stones removed from gall bladder.

Case 46. Mrs. J. E. C. February 4, 1915. Exploratory operation. Gall bladder found adherent, full of stones; much pus present. Stone removed from cystic duct.

4. Patients Living and Well, Ten or More Years After Operation

Case 1. Mrs. J. H. H. June 9, 1911. Gall-bladder symptoms for 15 years. Typhoid fever 18 years ago. Mid-line incision. Modified Gilliam suspension and appendectomy. Right rectus incision. Gall bladder filled with viscid tarry bile. No stones.

Case 2. Mrs. A. E. February 2, 1909. Sudden gall-bladder attack several days ago. Not relieved by morphine. Right rectus incision. Gall bladder much distended and adherent low down; forty cubic centimeters of pus. Many stones removed.

Case 3. Mr. E. D. L. June 9, 1907. Gastro-intestinal symptoms for 40 years. Jaundice accompanies these attacks. McBurney incision. Appendectomy. Right rectus incision. Gall bladder adherent, wall thickened. Stones removed.

Case 4. Miss S. F. J. November 26, 1910. Vague gastro-intestinal symptoms suggesting appendicitis or gall-bladder lesion. Right rectus incision. Normal appendix removed. Gall bladder adherent. Stones removed.

Case 5. Mrs. C. E. H. May 19, 1909. Marked pain and tenderness along right costal margin. Right rectus incision. Stones removed from gall bladder.

Case 6. Mrs. H. R. January, 1909. Severe gall-bladder attack 15 years ago. Frequent mild attacks since then. Appendix symptoms also. McBurney incision. Normal appendix removed. Right rectus incision. Gall bladder had evidently ruptured during attack 15 years before. Several stones embedded in adhesions outside the gall bladder removed. Adhesions released.

Case 7. Miss C. S. June 3, 1910. Typhoid fever 30 years ago. Frequent gall-bladder attacks. Right rectus incision. Appendectomy. Gall-bladder wall thickened and friable. Stones removed.

Case 8. Mrs. A. January 7, 1907. Frequent gall-bladder and appendix attacks. Acute symptoms for past 3 days. White blood cells 15,400. McBurney incision. Appendectomy. Right rectus incision. Gall-bladder wall thickened. Many putty-like stones. Redundant portion of gall-bladder wall was encrusted with calcareous plaques. This area of the wall was excised.

Case 9. Mrs. A. J. D. October 29, 1910. Gall-bladder history. Some symptoms due to a relaxed vaginal outlet. Repair of relaxed vaginal outlet. Dilatation and curettage. Right rectus incision. Appendectomy and removal of gall stones.

Case 10. Mrs. A. C. November 24, 1908. Acute gall-bladder symptoms. White blood cells 23,000. Temperature 103°. Right rectus incision. Some pus in gall bladder. Stones removed. Large stone in cystic duct; removed with difficulty.

Case 11. Mr. J. M. G. October 1, 1910. Indefinite gall-bladder attacks for 14 years. Suggestive of a duodenal ulcer? Right rectus incision. Gall bladder adherent. Much pus. Stones removed.

Case 12. Mrs. S. March 3, 1907. Acute symptoms with excruciating pain in past 9 hours. White blood cells 13,000. Right rectus incision. Appendix and gall stones removed.

Case 13. Rev. A. May 7, 1910. Numerous gall-bladder attacks with clay-colored stools and jaundice. Right rectus incision. Stones removed.

Case 14. Mrs. B. F. B. November 27, 1907. Appendectomy 5 years ago, by another surgeon.

Excruciating gall-bladder pain with jaundice for past 2 days. Right rectus incision. Gall bladder adherent. Stones removed. Cystic duct thickened and indurated.

Case 15. Mrs. E. W. May 14, 1907. Several severe gall-bladder attacks. Appendectomy and removal of gall stones.

Case 16. Mr. T. November 18, 1909. Acute gall-bladder symptoms for 2 days. Temperature 101°. Gall-bladder palpable, extends 4 centimeters below costal margin. Right rectus incision. Gall-bladder quite distended. Several irregular greenish spots on wall just ready to rupture. One hundred cubic centimeters of pus. Stones removed.

Case 17. Mrs. F. E. B. January 14, 1910. Gall-bladder history. Right rectus incision. Appendectomy. Gall bladder tremendously distended, reaches to umbilicus. Two hundred stones removed.

Case 18. Mrs. S. March 27, 1910. Definite acute attack. Suggests acute appendicitis or cholecystitis. McBurney incision. Normal appendix removed. Right rectus incision. Gall bladder distended. Stones removed.

Case 19. Mrs. C. W. June 21, 1907. Pelvic operation 2 years ago. Whitehead operation for hæmorrhoids and prolapsus. Suspension of uterus and release of adhesions. Typical gall-bladder attack at present time. Right rectus incision. Appendectomy. Gall bladder distended. No stones. Opened and drained.

Case 20. Mrs. K. K. October 17, 1911. Definite gall-bladder attack 2 years ago. Several attacks since then associated with jaundice and fever. Right rectus incision. Gall-bladder wall thin as parchment. Stones removed from gall bladder and cystic duct.

Case 21. Mrs. A. January 2, 1912. Typical intermittent attacks for 10 years associated with jaundice. Right rectus incision. Gall-bladder wall friable and thickened. No stones. Appendix removed.

Case 22. Miss M. A. H. April 3, 1911. Typical gall-bladder symptoms. Right rectus incision. Appendix adherent; removed. Gall-bladder adherent to stomach and duodenum. Stones removed. A considerable amount of inspissated bile.

Case 23. Mrs. W. M. June 17, 1901. Typical attacks for past 8 years associated with jaundice and clay-colored stools. Right rectus incision. Gall-bladder walls thickened. Gall-bladder embedded in adhesions. Stones removed.

Case 24. Mrs. T. August 15, 1908. Aged 60 years. She has been having gall-bladder attacks for 25 years. Acute attack at present time. Globular tender mass extends from costal margin to umbilicus. Right rectus incision. Empyema of gall bladder, which is quite adherent to transverse colon, stomach, and abdominal wall. Wall of gall bladder 1 centimeter thick. Large amount of pus. Several drams of sand-like calcareous material. Two-thirds of gall-bladder wall removed.

Case 25. Mrs. M. W. January 5, 1907. Vague gastro-intestinal symptoms. Mid-line incision. Pelvic organs normal. Right rectus incision. Gall bladder quite adherent but contained no stones.

Case 26. Mrs. A. M. May 1, 1910. Frequent typical attacks with jaundice. Right rectus incision. Gall-bladder wall thickened. Stones removed. One stone in common duct.

Case 27. Mrs. C. S. December 19, 1910. Now in fourth week of typhoid fever. Sudden gall-bladder symptoms. Temperature 102.5°. Round, tender, globular mass below right costal margin. Right rectus incision. (Gas anæsthesia.) One hundred cubic centimeters of pus. Gall-bladder walls were adherent, thickened, and friable. Stone was removed.

Case 28. Miss J. C. October 5, 1906. Typical attacks for 2 years. Right rectus incision. Gall-bladder adherent to duodenum. Stones removed.

Case 29. Miss B. L. May 13, 1908. Typical attacks for 10 years associated with jaundice. Right rectus incision. Gall bladder adherent. Stones removed.

Case 30. Mrs. L. I. H. June 27, 1908. Several attacks associated with jaundice. Present attack of 48 hours' duration. Right rectus incision. Gall bladder adherent to omentum. Contains large amount of mucus and pus. Walls injected. No stones.

Case 31. Mrs. C. P. K. October 6, 1904. Typical symptoms. Right rectus incision. Gall bladder 8 inches long. Wall thickened and friable. Much pus. Stones removed.

Case 32. Mr. J. January 6, 1910. Typical symptoms. McBurney incision. Appendix injected, removed. Right rectus incision. Gall-bladder wall gangrenous and had ruptured at one point. Much pus. Stones removed.

Case 33. Mr. J. W. July 5, 1910. Frequent attacks. Acute attack at present time. Right rectus incision. Gall bladder ruptured. Five hundred cubic centimeters of dark bile in peritoneal cavity. Gall bladder extends down to umbilicus. Liver margin covered by greenish yellow exudate. Twenty-one stones removed. Drained through right rectus and McBurney incisions.

Case 34. Mrs. O. M. B. January 9, 1909. Acute gall-bladder attack. Right rectus incision. Gall bladder enlarged, indurated and œdematous. Much pus. Stones removed.

Case 35. Mr. A. W. June 30, 1904. Typical attacks. Right rectus incision. Numerous adhesions, but no stones. Appendix removed.

Case 36. Mrs. W. February 24, 1904. Has lost 40 pounds in 4 months. Malignancy of body of uterus suspected. Mid-line incision. Pelvic organs normal. Right rectus incision. Gall-bladder walls thickened and indurated. Stone wedged in cystic duct. Stone removed. Cystic duct had to be incised; cystic duct closed with catgut.

Case 37. Mrs. J. C. April 9, 1902. Frequent typical attacks with jaundice. Right rectus in-

cision. Gall bladder distended and adherent. Stones removed.

Case 38. Mrs. R. P. L. May 31, 1911. History of typhoid fever. Several typical gall-stone attacks. Acute attack at present time. Two months pregnant. Right rectus incision. Appendectomy. Stones removed. Pregnancy went to term. Child living and well.

SUMMARY OF CASES OF PATIENTS WHO DIED LATER OF SOME OTHER DISEASE—NO RETURN OF GALL-BLADDER SYMPTOMS

Case 1. Mrs. F. M. October 30, 1917. Many gall-bladder attacks. Gall bladder thickened; walls friable. Many stones removed. Gall bladder drained. The patient did very well for several years. Her physician states that carcinoma of the liver developed, of which she died.

Case 2. Mrs. H. H. October 14, 1920. Definite gall-bladder history. Stones removed and gall bladder drained. Did well for 10 years. Her physician states that signs of malignancy then developed and the patient soon died.

Case 3. Rev. A. November 23, 1904. Stones removed and gall bladder drained. Died 1 year later of carcinoma of the liver.

Case 4. Mrs. J. R. January 4, 1915. Typical symptoms. Stones removed and gall bladder drained. Noted at operation that the common and cystic ducts were indurated and that the pancreas was twice the normal size and quite indurated, suggesting malignancy. The patient recovered but died of carcinoma of the pancreas a year later.

Case 5. Mrs. W. S. June 7, 1916. Typical gall-bladder symptoms. Active pulmonary tuberculosis at the time of operation. Operation performed under local anæsthesia. Pancreas three times the normal size and indurated. Small nodule in liver. Gall bladder drained. The patient did well. Drainage sinus closed. Death within a year of carcinoma of the pancreas.

Case 6. Mrs. C. H. L. February 26, 1919. Definite gall-bladder history. Mid-line incision. Chocolate-colored fluid in abdomen. Ruptured ovarian cyst, left. Myomata uteri. Uterus and left ovary removed. Right rectus incision. Stones removed from gall bladder and cystic duct. Sections of the ovary show carcinoma. The patient died 2 years later of carcinoma. No return of gall-bladder symptoms.

Case 7. Mrs. W. T. S. November 22, 1904. Symptoms for 12 years preceding operation. Stones removed and gall bladder drained. She was perfectly well until January, 1919, when she began to have gastric upsets. A palpable tumor soon appeared in the region of the pylorus. Death in December, 1920, from carcinoma of the stomach.

Case 8. Mrs. J. W. July 8, 1920. A few gall-bladder attacks. Appendectomy. Stones removed and gall bladder drained. Carcinoma of the breast later and death from metastases. No return of gall-bladder symptoms.

Case 9. Mrs. E. K. June 8, 1907. Pain and intermittent jaundice for 2 years. Marked jaundice at time of operation. One hundred stones removed. Gall bladder drained. Death several years later from cardiorenal condition.

Case 10. Mrs. L. T. February 8, 1910. Definite gall-bladder attacks. Compensated cardiac lesion at time of operation. Pericholecystitis found. No stones. Adhesions released. Gall bladder drained. Sudden death from "heart trouble" 3 years later.

Case 11. Mrs. E. S. May 6, 1908. Definite gall-bladder symptoms. Adhesions released, frank pus in gall bladder. Stones removed and gall bladder drained. Death several years later from a cardiorenal condition.

Case 12. Mrs. J. R. E. September 17, 1899. Acute attack of 2 weeks' duration. Marked jaundice. Clay-colored stools. Bile in urine. Temperature 103°. Stones removed from gall bladder and cystic duct. Complete recovery. Died at age of 76 from a cardiorenal condition—24 years after operation.

Case 13. Mrs. E. L. January 10, 1903. Adhesions released, stones removed. Death some years later from chronic interstitial nephritis. No return of gall-bladder symptoms.

Case 14. Mrs. E. N. June 21, 1918. Mid-line incision. Modified Gilliam suspension of the uterus. Appendectomy. Stones removed and gall bladder drained through a right rectus incision. Perfectly well until June, 1921; a little later died of acute nephritis.

Case 15. Dr. F. J. O. October 23, 1918. Appendectomy. Stones removed and gall bladder drained. In December, 1920, the patient collapsed with signs of uræmia and soon died.

Case 16. Mrs. C. R. March 11, 1909. Acute cholecystitis. A thin frail woman with a cardiac condition and partial decompensation at time of operation. Two large stones removed. No return of symptoms. Death in 1912 from lobar pneumonia.

Case 17. Miss E. L. R. November 27, 1908. Chronic cholecystitis and cholelithiasis. Stones removed and gall bladder drained. Death several years later from pneumonia.

Case 18. Mrs. K. H. June, 1908. Chronic cholecystitis and cholelithiasis. Acute exacerbation. Stones removed. Wall of gall bladder 6 millimeters thick, very friable. Perfectly well for 12 years. Death from pneumonia.

Case 19. Mrs. S. June 26, 1901. Pleurisy and pneumonia 3 years before operation. Abscess found between abdominal wall and liver. Gall bladder involved. The patient made a satisfactory recovery and lived 16 years. She died of pneumonia.

Case 20. Mr. J. H. March 11, 1911. Acute cholecystitis. Gall bladder adherent. Large amount of gritty material obtained. No return of gall-bladder symptoms. Death from bronchopneumonia.

Case 21. Mrs. J. W. H. February 13, 1914. Chronic cholecystitis. Stone removed from gall

bladder. Patient recovered completely. Death 6 years later from cerebral hæmorrhage.

Case 22. Mrs. H. O. B. April 30, 1912. Chronic cholecystitis with acute exacerbation. Many stones removed from gall bladder. Several removed from the cystic duct. Complete recovery. Death 8 years later—apoplexy.

Case 23. Mrs. A. March 25, 1908. Acute symptoms for 3 days. A very fat woman. Acute bronchitis. Albumin and casts in urine. Gas anæsthesia. Fifty stones removed. Gall bladder gangrenous. Complete recovery. Death 11 years later—apoplexy.

Case 24. Mrs. H. S. April 11, 1905. Intermittent attacks for 8 years. Acute exacerbation at time of operation. Stones removed from gall bladder and cystic duct. No return of symptoms. Over 80 years old at time of death. Cause of death, "complications."

Case 25. Mrs. R. March 6, 1909. General peritonitis at time of operation, thought to be due to a ruptured gangrenous gall bladder. Exudate over liver, stomach, and colon. Gall bladder drained. Appendix normal. Recovered. Death several years later, cause unknown.

Case 26. Mrs. A. P. August 19, 1902. Chronic cholecystitis. Adhesions released. Gall bladder drained. No return of symptoms. Cause of death, unknown.

Case 27. Mrs. E. B. April 25, 1911. Acute attack at time of operation. Stones removed. Gall bladder drained. The patient lived 9 years. No return of symptoms. Cause of death, unknown.

Case 28. Mr. S. July 10, 1911. Symptoms for years, exacerbation at time of operation. Few stones, large amount of putty-like material and some pus. Cystic duct not obstructed. Death 4 years after operation. Cause, unknown.

Case 29. Mrs. L. D. December 31, 1915. History of several acute attacks. Onset of last attack 24 hours before operation. One hundred stones removed. No return of symptoms. Death 3 years later from Hodgkin's disease.

Case 30. Mrs. A. D. May 17, 1919. Chronic cholecystitis. Exacerbation at time of operation. Gall bladder quite adherent. Many stones removed from gall bladder and cystic duct. No return of symptoms. Death from pellagra.

Case 31. Mrs. R. H. McB. July, 1918. Chronic cholecystitis. Diabetes. Operation delayed 6 months because of severity of diabetes. Appendix removed. Stones removed from gall bladder. The patient did well for 1 year. Death due to diabetes.

Case 32. Mrs. J. F. B. April 13, 1921. Gall-bladder symptoms for 15 years. Sixty stones found in gall bladder. The patient recovered, but about 1 year later developed a right perinephritic abscess and died soon after operation.

Case 33. Mrs. S. C. D. October 1, 1903. Definite history of frequent attacks. No stones found. Numerous adhesions. Gall bladder drained. Complete recovery. She developed a psychosis and committed suicide years later.

Case 34. Mr. J. D. April 22, 1920. Indigestion for 20 years. Gridiron incision. Appendix adherent, removed. Liver 10 centimeters below costal margin. Gall bladder far up under liver. Gall bladder drained. Papillomatous growth removed from pyloric end of stomach. Death about 3 years later from gastric carcinoma.

Deducting the patients who have died from any cause and those who have not been located, there remain 210 in our series who are living and have been communicated with. The results in these cases may be briefly summarized as follows:

Unimproved	*16
Improved	26
Well	168
	210

*Four of these were well but not until after second operation.

PREVAILING CONCLUSIONS

As far as I have gone, the prevailing opinion among gastro-enterologists about the postoperative complications in gall-bladder surgery seems to be that neither cholecystectomy nor cholecystostomy with drainage will prove satisfactory in all cases, so that it becomes a question of choosing the operative procedure which will give the highest percentage of recoveries. It is quite certain that in Dr. Cullen's hands the operative procedure described has produced excellent results.

What would have been the results in the present series of cases had cholecystectomy been the routine operative procedure? One might venture to say that the immediate mortality would have been much higher in the hands of the average surgeon and the percentage of recoveries would have been no better. Recurrences are possible even after cholecystectomy. In the very cases in which the gall bladder should be removed the patient's condition or the nature of the lesion may make its removal impossible. In these cases cholecystectomy would give a very high immediate mortality, and in case the patient survived, the postoperative complications would probably be just as severe and numerous as after cholecystostomy and drainage. In the very cases in which the gall bladder can be readily and is most frequently removed, one gets excellent results from drainage.

Unfortunately, we have not obtained complete bacteriological studies in our cholecystitis cases and the stones have frequently not been analyzed. It is suggested that these factors be studied more thoroughly in the future. The type of organism, or the formation of the stone, may have an important bearing on the decision as to the most appropriate operative procedure.

Whether we should remove the gall bladder or should drain it is still an unsettled question. After careful analysis of the present group of cases my own personal view is that drainage of the gall bladder is the safer and easier procedure in the hands of the average surgeon and in the average case. If a second operation should become necessary, cholecystectomy should be seriously considered. No hard and fast rules can be laid down. Each case must be considered by itself. We shall look forward with interest to the careful tabulation of gall-bladder results from other clinics, for it would seem that reports of large series of such cases, each coming under the care of the same surgeon, would go far to help in the solution of these problems.

In conclusion I wish to thank Dr. Cullen for placing at my disposal his excellent personal records of all his private patients and for his valuable assistance and suggestions in the preparation of the data and the writing of this paper. I wish also to thank Mr. Max Broedel for his striking illustrations. Miss Margaret Brogden, director of the Social Service Department of the Johns Hopkins Hospital, has kindly helped me to locate many of the patients. Miss Dorothy M. Collins has been of the utmost assistance in the typing and preparation of this paper.

I should be remiss did I not also express my sincere thanks to the physicians and relatives who have so kindly furnished me with the information relative to the patients.

THE TREATMENT OF DUODENAL FISTULA

With Report of a Case[1]

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UNDOUBTEDLY the occurrence of the usually serious and frequently fatal condition of duodenal fistula is far more common than the number of reported cases would lead one to suspect. In quite a careful search of the literature I am able to find only 28 cases. Complete reports are entirely wanting in several of these. Since the subject heading occasionally gives no information as to the occurrence of a duodenal fistula, it is not unlikely that a considerable number of case reports have been overlooked. However, others have commented recently on the scarcity of the literature on this subject; thus, Hendon (11) says that "the subject of duodenal fistula, traumatic in origin or otherwise, is accorded scant consideration by the majority of surgical authors."

There is no evidence at hand that any one has had much experience with this condition. Most writers base their remarks upon their experience with one or two cases.

Of the several stated primary etiological factors, by far the most frequent is trauma to the duodenum, either through operative procedures or from external violence. While operative trauma in these cases is sometimes intentional, as in transduodenal removal of a common duct stone, accidental injury, often not noticed at the time, is much more common and, obviously, also much more serious. Of these accidental operative traumas, injury to the duodenum through including a part of it in the bite of a pedicle clamp in right side nephrectomy, has been emphasized by W. J. Mayo (16) who has seen three such cases, all of which terminated fatally. Injury to the duodenum with resulting fistula formation has been reported a number of times in operations on the gall bladder and biliary ducts. In some instances it has been a laceration, either recognized at the time and closed immediately or not recognized and consequently left open.

The evidence is overwhelming that the gauze pack has resulted in the formation of a number of fistulæ, especially in cases in which an opening in the duodenum has been closed and the gauze pack inserted against the suture line. Frequently the fistula has first appeared immediately upon the removal of the pack on the fourth or fifth day, or, as happened in one case, at the end of 3 weeks. It is evident that the gauze pack should never be employed in such cases; yet it is still advocated and used in these very cases by some surgeons.

Laceration and rupture of the duodenum with fistula formation have followed blows and kicks on the abdomen and other forms of external violence.

After trauma comes perforated duodenal ulcer as the second most common primary etiological factor. In these cases in particular the gauze pack should be feared.

Leakage in the suture line of the closed end of the duodenum, in gastric resection cases, is apparently one of the less frequent etiological factors. This leakage may result from an imperfectly applied suture, or, as probably happens more frequently, to the breaking-down of the suture line several days after operation. At any rate, most severe forms of duodenal fistulæ occur in these cases, according to Furtwaengler (9). The case reported in this paper is of this type.

Several other much more infrequent primary etiological factors are to be found in the abstracts of the reviewed cases which are recorded at the end of this paper.

[1] Since sending this article to the publisher I have accidentally discovered a very brief report of a case of duodenal fistula by Dr. Seward Erdman, in which he states that a suction apparatus was employed in the treatment of the fistula. Two figures illustrating the suction apparatus accompany the report. This case was reported before the New York Surgical Society, February 9, 1921. The transactions of this meeting were published in *Annals of Surgery*, 1921, lxxiii, 793–795. This is the only report of the employment of a suction apparatus in the treatment of a duodenal fistula of which I have knowledge, and the reason I overlooked it is apparent when one consults the *Quarterly Cumulative Index to Medical Literature* and the *Index Medicus* for this period, in neither of which is this report listed.

There are a number of contributing factors which are of the greatest importance at times. They all may be present in one case and lacking in another. They are (1), the proteolytic action of the duodenal discharge; (2) infection; (3) the considerable intraduodenal pressure at times; and (4) the greatly diminished resistance of the patient.

The highly irritating and destructive action of the duodenal discharge, which manifests itself so strikingly at times, is due for the most part to the contained trypsin. The tissue of the duodenal wall, when sufficiently impaired through trauma or disease, is disintegrated readily by this powerful enzyme which is active "in neutral as well as in slightly acid or markedly alkaline solutions" (Howell, 12). Once outside the bowel it readily attacks normal tissue with the result that this rapidly progressive destructive process will end fatally if unchecked.

Infection is frequently of great importance. Besides having its origin in the duodenum itself, it often extends to this structure from the kidney or gall bladder, sometimes with abscess formation. The infected tissue is readily attacked by the tryspin.

The sudden increase of the intraduodenal pressure through delivery of gastric content is obviously a factor in the giving way of a weakened area in the duodenum; also the peristalsis thus created is a factor detrimental to the repair of a defect in the wall of this structure.

No doubt local tissue resistance is lessened considerably in those cases in which nutrition suffers severely.

The time of appearance of duodenal fistula following a primary condition varies considerably. Sometimes several weeks intervene, although this is unusual. As a rule, it develops within 4 to 9 days. The amount of discharge is usually small at first, but frequently increases rapidly, becoming enormous at times. In some cases, particularly those in which no tryptic action is manifested, it is slight at all times. The amount and also the character of the discharge are modified greatly by the quantity of food and water taken *per os*. Bile is not constantly present, particularly if the duodenal defect is located a considerable distance proximal to the ampulla of Vater; likewise tryptic action is less apt to be present under similar conditions.

The most important factor influencing the appearance of the tissues of the fistulous tract and the surrounding skin is the presence or absence of trypsin in the discharge. When it is present the surrounding skin is markedly inflamed, eroded, and macerated, becoming darkly discolored at times. The extent of skin involvement is sometimes enormous. It is frequently limited to the area covered by the saturated dressings. Palmer (21) states: "The digestion of the skin of the abdomen and back is so rapid and unrelenting as to make the life of the patient a hardship to himself because of the discomfort and pain, and to the nursing force because of the frequency of the needed dressings."

The fistulous tract often opens into a widely gaping abdominal wound which is open throughout a greater part of its length. Its surfaces are usually acutely inflamed. Here and there may be seen bleeding points. Hæmorrhage from the wound is sometimes serious. Fat necrosis is rarely present.

In most cases the diagnosis offers no difficulty. The escape of characteristic duodenal contents is conclusive evidence. At times, especially in the onset, the diagnosis may be doubtful as, for instance, when the discharge is non-irritating, not excessive, and contains bile with no striking evidence of gastric content.

The clinical course of these cases varies greatly, depending upon the character of the fistula. There are all graduations, from the type characterized by a minute opening in the duodenum with only a slight non-irritating discharge, to the type in which the discharge is enormous and frightfully destructive. Spontaneous healing may occur in the first type but never in the second. Ordinarily, spontaneous healing does not occur in duodenal fistulæ. The rule is that the condition becomes progressively worse and ends fatally unless treated.

The progress of the condition is rapidly fatal in those cases in which practically the entire duodenal content escapes by way of the fistula. The enormous interference with

metabolism together with the local destructive process may result in death in 2 or 3 days. This rapid depletion is not present in those cases in which the gastric content enters the jejunum by way of an artificial stoma, as, for instance, in gastric resections of the Billroth II and Pólya types.

The most frequently stated causes of death are exhaustion, emaciation, and peritonitis. Probably another cause of death is a toxæmia, other than bacterial, such as Kanavel (13) has described in extraperitoneal rupture of the duodenum.

The prognosis is usually grave. In 1914 Pannett (22) said that "as far as can be ascertained from writings of the last 10 years, a duodenal fistula never heals without surgical aid, and, if left, is invariably fatal." This is too sweeping a statement in view of some of the case reports of the last few years in which spontaneous healing did occur; also, some cases treated non-surgically cleared up promptly and completely. This same writer added further that "recovery from a duodenal fistula, even with adequate surgical treatment is a rarity. Only three cases are to be found in the writings of the last 10 years." According to McGuire (19) the condition is a serious one and the best method of dealing with it has not yet been clearly settled; he says also that "usually the destructive action of the digestive secretions causes the fistula to enlarge, and unless there is surgical intervention the patient dies." Hendon (11) reports that "regardless of its mode of origin, duodenal fistula represents an exceedingly dangerous lesion." In speaking of duodenal fistulæ with outpouring of duodenal content, particularly the pancreatic juice, Einhorn (7) states that the prognosis is "very grave indeed." Referring to fistula due to duodenal trauma from nephrectomy, W. J. Mayo (16) states that "a most distressing type results which will often, if not usually, cause the death of the patient." In this series of twenty-eight cases the mortality is approximately 43 per cent.

Numerous operative and non-operative measures have been employed in the treatment of this condition, all of which aim at the same ultimate result, namely, the closure of the duodenal defect either by means of suture or spontaneously. Unhappily the closure by means of sutures is usually a failure as the suture line may give way sooner or later. Excluding Souttar's (19) case, because of lack of details, this operation, either alone or in conjunction with some other, was performed six times, with five failures. The one successful case is that reported by W. J. Mayo (17). In this case a perforation on the posterior duodenal wall, secondary to surgical procedures on the right kidney in the presence of infection, was closed as soon as observed. The situation of the defect in the other five cases was on the anterior wall three times and once it involved both the anterior and posterior surfaces. Information is lacking in one case.

From this evidence it would seem that this procedure is unwarranted in most instances, particularly in cases where the defect is large and its borders unfavorable for wound healing. If the opposite conditions prevail, which is quite unusual, then this procedure alone or in conjunction with some other may be looked upon favorably.

With immediate closure out of the question, one or two very serious conditions frequently confront one. As a rule either of these conditions, if not corrected, leads to a fatal termination. The first and more serious of these is the discharge through the fistula of everything which enters the duodenum from the various sources. Rapid loss of strength and resistance results, and death occurs within a few days. The second condition is the powerful digestive action of the pancreatic juice on the fistulous tract, the wound, and the surrounding skin. This may give rise to early peritonitis.

The treatment in these cases aims at the spontaneous closure of the duodenal defect through the correction of these unfavorable conditions. The methods employed are operative, medicinal, and mechanical, either alone or in combination.

Of the operative procedures the following have been employed: (1) gastro-enterostomy, (2) gastro-enterostomy plus pyloric occlusion, and (3) jejunostomy.

Gastro-enterostomy alone has been uniformly unsuccessful as the stomach does not

empty through the artificial stoma; in other words, this operation accomplishes nothing in the presence of a patent pylorus.

Gastro-enterostomy with occlusion of the pylorus, which was advocated first for these cases by Berg (2), is a very satisfactory procedure so far as the two alarming conditions previously mentioned are concerned. However, in many instances, the patient's general condition is so poor when this operation is performed, that death results. Another serious objection to this or any other operative procedure which involves the infected fistulous tract is the great danger of peritonitis. Furthermore, this operation is out of the question in fistula cases following gastric resections of the Billroth II or Pólya types, for here the altered anatomical relation of the stomach to the duodenum and jejunum is exactly what the Berg operation accomplishes. In these cases a duodenal fistula may not only fail to close spontaneously but actually develop, in spite of a gastro-enterostomy together with what amounts to a pyloric occlusion.

Jejunostomy is a much simpler procedure than the one just described and does not imperil the life of the patient nearly as much, either because of its extent or the danger of peritonitis. It accomplishes a great deal, spontaneous closure of the fistula occurring in favorable cases.

Medication to curtail or to inhibit the secretion of digestive ferments accomplishes little if anything. The withholding of food *per os* is important in this connection; also, it does away with a mechanical factor of some importance in interfering with the closure of the fistula. Rectal feedings for a period long enough to insure healing of the fistula do not suffice when food is withheld *per os*, so some other method of feeding has to be resorted to.

Attempts at neutralization of the trypsin in the duodenal discharge are futile, especially so when alkaline solutions are used for the purpose, since this ferment is active even in markedly alkaline solutions. A fairly strong acid medium will curtail or inhibit tryptic activity but can not be employed satisfactorily due to injury to the tissues.

Ointments and rubber solution applied to the skin aid greatly in protecting it. Liquid petrolatum has been given *per os* as well as applied locally to coat the surface of the fistulous tract.

In order to dilute the trypsin contained in the the fistulous discharge so that wound healing could take place, Cheever (4) and later Palmer (21) directed a continuous stream of water into the fistula over a period of days. Palmer added an alkali to the water. This measure gave favorable results so far as the fistula is concerned in these two cases, but was extremely laborious and sloppy, and in Palmer's case it had to be discontinued because of extensive irritation to the surrounding skin from the overflow on to it.

Packing the fistulous tract with gauze saturated with something such as olive oil has been done in mild cases. Obviously, there are numerous objections to this method, especially in the presence of marked infection and tryptic action.

Recently Einhorn employed a jejunal tube very successfully in the treatment of two fistula cases, in one of which the tryptic action was pronounced while it was absent in the other. This tube was in place 2 days after its introduction *per os*. By means of it, two very important things are accomplished, namely the satisfactory administration of food and water over a prolonged period of time, and, second, the marked curtailment or inhibition of the discharge from the fistula. Thus, at little or no risk to the patient, conditions favorable for the spontaneous closure of the fistula are brought about. This procedure fails in pyloric obstruction cases and would probably be carried out with difficulty in some gastric resection cases of the Billroth II type.

A short time ago I employed a highly satisfactory and extremely simple procedure in the treatment of a duodenal fistula patient whose condition was very serious, because of the rapidly progressive and destructive tryptic action involving extensive skin areas and the abdominal wound. I refer to the employment of a continuous suction apparatus such as is frequently used in the treatment of wounds in which the drainage is considerable.

Upon reviewing the literature, after having treated this case in this manner, I was unable

to find a case report where such a procedure was ever carried out. This is particularly worthy of note in view of the fact that only recently, as has been mentioned already, several cases have been reported in which the local condition gave rise to the gravest concern and yet in its treatment laborious, sloppy, and, in some respects, quite unsatisfactory, non-operative measures were resorted to. It is true that Cheever, in 1915, mentioned the suction method of treatment, stating that it had been employed by Jones and Williams. However, he did not comment further on it, nor did he employ it. Apparently Jones and Williams made no report.

My case is that of a man upon whom I did a partial gastrectomy for carcinoma of the stomach, January 10, 1923.

An anterior Pólya operation was performed. The free duodenal stump was rather short and was closed with some difficulty by means of a Connell and two continuous Lembert sutures; chromic catgut was used for the inner row and linen for the two outer rows of sutures. A soft rubber (Penrose) drain was inserted down to the suture line. The abdominal wound was closed in the usual way. Nothing was given the patient *per os* for 4 days; then fluids and semisolid food were given. Until the sixth day there was nothing noteworthy in the patient's condition. On the seventh day, bile was first observed in the discharge from the wound, which had been serous in character and moderate in amount until then. This bile-colored discharge increased in amount quite rapidly, becoming profuse in a few days. On the eleventh day the discharge was noticed for the first time to be irritating to the surrounding skin, which was found to be severely inflamed. The extent of the cutaneous involvement corresponded exactly to the area of skin which was covered by the saturated dressings. Zinc oxide ointment was applied to the involved skin area. On the twelfth day the local condition was very much worse; a wide cutaneous area, surrounding the fistula, was acutely inflamed and blood oozed in places. The wound had opened up in its middle half; its surfaces were likewise intensely inflamed and were bleeding slightly in places. No fat necrosis was found on numerous careful examinations. The patient complained of severe burning pain in the involved area. While the general condition was excellent at all times, the local condition was alarming. The discharge was so profuse and irritating that the dressings had to be changed every 1 or 2 hours. It was at this time that an ordinary rubber catheter with several added openings was introduced into the fistulous tract as far as possible; it was then connected up with an electrical suction apparatus

Fig. 1. Suction apparatus in place, as used in the treatment of the author's case of duodenal fistula.

which was run continuously for the next 11 days. Five to seven hundred cubic centimeters of bile-colored material were thus recovered every 24 hours, with no discomfort whatever to the patient and also with no effort as far as the nursing staff was concerned. But what is of the greatest importance, the local condition began to clear up remarkably fast almost immediately. The skin was irritated no longer and the fistulous tract very little, if any, since the discharge was removed just as soon as it escaped from the duodenum. Marked tryptic action of the recovered material was demonstrated by both the Gross and Mett tube methods. Within 4 or 5 days the irritated skin appeared nearly normal. By this time, too, the wound and fistulous tract were well on the way to closure by granulation tissue. On the eleventh day after institution of this suction treatment the discharge stopped quite abruptly and completely.

The patient's diet was never interfered with during this treatment. His general condition improved all the time. He was discharged 1 week after cessation of the discharge. At that time his wound was healed completely.

Although the general condition of this patient was good at all times, since there was no appreciable disturbance in nutrition incident to the fistula, still there did exist an extremely serious condition, namely, a rapidly progressive and extensive destruction of tissue which apparently would have terminated fatally if unchecked. By the employment of an extremely simple apparatus, and with no discomfort to patient or nurse, all that could be desired in the way of a rapid, spontaneous healing of the duodenal defect was accomplished. It should be emphasized, too, that this procedure can be instituted immediately

upon discovery of a fistula and with no risk whatsoever to the patient. Much time would have been saved had this been done in this case, since the destructive process would have been wholly prevented.

CONCLUSION

Because of its great effectiveness, extreme simplicity, general adaptability, and freedom from danger, the suction method of treatment in local destructive processes in duodenal fistula cases should always be employed whenever this condition continues to exist.

This procedure alone will suffice in the treatment of certain types of serious cases. It often can be combined advantageously with other methods of treatment.

CASE REPORTS FROM THE LITERATURE

Case 1. Berg's (1) first case: A cholecystduodenostomy was done with a Murphy button in a case of obstructive jaundice due to a carcinoma of the head of the pancreas. Five days later a duodenal fistula developed. The duodenal defect was closed by suture but re-opened on the fourth day. An anterior gastro-enterostomy with a Murphy button was done; at the same time the pylorus was occluded by means of a silk ligature. Eleven days later, as the ligature cut through, the occlusion of the pylorus was maintained by inverting the gastric and duodenal walls over the line of the ligature. There was never any discharge of chyme from the duodenal fistula after the gastro-enterostomy and pyloric occlusion. Death occurred 17 days after the last operation from exhaustion.

Case 2. Berg's (1) second case: Patient had a perforated duodenal ulcer about the size of a pea, which involved the anterior surface of the first part of the duodenum. The edges of the ulcer were gangrenous. The perforation was closed with three layers of Lembert sutures. Seven days later the suture line gave way and a fistula occurred. A posterior gastro-enterostomy was done; at the same time the opening in the duodenum was closed again. Two days later the suture line in the duodenum gave way again. Several more attempts were made to close this opening, all of which failed ultimately. Ten days after the gastro-enterostomy operation, the pylorus was occluded by means of a broad tape. There was no fistula leakage during the next 24 hours. The patient died without ever having rallied from the operation.

Case 3. Cameron's (3) case: A man suffered from a duodenal fistula, which refused to close. A posterior gastro-enterostomy was performed but the fistula refused to heal, and the intestinal contents still escaped. A second laparotomy was performed, the pylorus was ligated, and the fistula healed almost immediately.

Case 4. Knagg's (14) case: A fistula developed secondary to an operation through the right loin for opening an abscess. A drainage tube was inserted. Later the sinus tract was opened and the fistula developed within a few days. It persisted for weeks. About 3½ months later (after onset of fistula) a posterior gastro-enterostomy was done and the pylorus infolded by two rows of Lembert sutures parallel to its long axis. There was marked immediate improvement in the fistula and ultimate recovery.

Case 5. Esau's (8) case: An abscess in the right kidney region of one month's duration was opened. It followed a blow in the right side. A lacerated and infected kidney was removed also, and the wound was loosely tamponaded. The pack was removed at the end of 3 days and a new one inserted. A fistula developed the same day. With no further comments the author states that pancreatic juice was apparently present in the discharge. Closure of the opening, which was the size of a mark, was out of the question, due to its inflamed, œdematous, ragged, and friable margin. On the third day after the appearance of the fistula a jejunostomy (Y-shaped) was performed. Death occurred 6 days later from exhaustion.

Cases 6, 7, 8. Collective report (Struthers et al, 24). In a series of perforated duodenal ulcers "a duodenal fistula developed in the three cases in which the perforation was not closed at the time of the operation. All three cases died within a few days with rapid emaciation and asthenia."

Case 9. Winiwarter's case (26): A rupture of the pars horizontalis duodenum was sustained following a kick on the abdomen. The entire anterior wall and a part of the posterior wall were involved. Closure was made after 24 hours with three rows of sutures. The mesocolon was sutured to the place of closure. A gauze pack was inserted. A fistula developed 2 days later. The margins of the skin were darkly discolored. Abundant wound secretion escaped. The general condition was good for 4 days and then declined rapidly. Salt solution and nourishment were given per rectum. On the sixth day dehydration and loss of strength were marked. The discharge from the wound was copious. An enterostomy (nearest loop) was done to give nourishment. Death occurred 2 days later from peritonitis.

Case 10. Thévenard's (25) case: A fistula developed "secondary to a sinus of 10 years' duration, following a nephrectomy. The fistula was probably tuberculous and had shown intermittent abscess formation. Healing of the fistula followed gastro-enterostomy plus pyloric exclusion."

Case 11. Souttar's (18) case: "The fistula resulted from the perforation of an ulcer of the duodenum following an extensive burn in a child. Bile and pancreatic juice escaped for 9 days. The abdomen was explored, the ulcer found and sutured, posterior gastro-enterostomy performed, and, finally, the pylorus was infolded. The child recovered."

Case 12. Case seen by Mayo (16): A nephrectomy was done on a kidney on which a nephrotomy had been performed. Pedicle clamps were left in place. "On the fourth or fifth day a copious discharge began of biliary and pancreatic secretions, with food discharged almost as quickly as taken. The patient became rapidly exhausted and died in 2 weeks."

Case 13. Mayo's (16) case: A nephrectomy was done for a carcinoma of the pelvis of the kidney. Heavy toothed forceps were applied to some vessels which were torn across. The forceps were left *in situ*. A duodenal fistula was discovered on the fifth day. The discharge was profuse. Death occurred 5 days later. Autopsy showed the fistulous opening to be in the descending portion of the duodenum.

Case 14. Case seen by Mayo (16): A fistula developed following a nephrectomy, which was undoubtedly due to trauma to the duodenum through the application of heavy forceps after the kidney had been torn loose from an infiltrated pedicle. "The fistula was small at first, but gradually increased in size." Death occurred 2 weeks later. "One feature in all these cases (11, 12, and 13) was the action on the skin of the escaping secretions. Large areas of the neighboring integument became scalded, painful, and

irritated. In one patient this set up a rapidly spreading eczema and in a week a great part of the skin of the body was affected."

Case 15. Pannett's (22) case: Upon operation a perforated duodenal ulcer was found on the anterior wall of the first part of the duodenum. The size of the perforation was approximately equal to the diameter of a lead pencil. This perforation was closed with three rows of non-absorbable sutures. Gauze drain was inserted down to the site of perforation. With removal of this gauze on the fourth day a fistula developed, from which the discharge was profuse. Food was withheld *per os* and rectal feedings, also glucose and saline injections, were resorted to, but the patient's condition became desperate. By the fourth day after the fistula developed the wound was widely gaping, and the edges were infected and partly digested by the pancreatic fluid. A jejunostomy of a type original with the author was performed and feedings carried out through the new opening. Spontaneous healing of the fistula resulted in a short time.

Case 16. Mayo's (17) case: A sinus developed secondary to a pelviolithotomy. The sinus was enlarged and finally a strip of iodoform gauze was placed in the wound. The next day a fistula developed from which, upon removal of the gauze on the second day, "there was an abundant discharge of bile, pancreatic and duodenal secretion, and some particles of food." At operation, which was performed immediately, an "opening of sufficient size to admit the end of a finger was found in the posterior wall of the duodenum (posterior attachment)." This opening was closed by sutures and an uninterrupted recovery followed.

Case 17. Cheever's (14) case: "A traumatic rupture of the duodenum on its posterior aspect, about 3 centimeters distal to the pylorus" was both intraperitoneal and extraperitoneal. This opening was closed with chromic catgut 8 hours after the injury. Drains were inserted down to the site of injury. Five days later a duodenal fistula developed. The fistulous discharge was profuse and extremely irritating, "causing the wound to re-open throughout its length, undermining the skin and rapidly digesting the skin edges and the tissues of the abdominal wall." A small rubber tube was carried down to the bottom of the wound, and held in place by appropriate means, and a continuous irrigation of the sinus with sterile water inaugurated, the overflow being conducted into receptacles by means of banks of rubber tissue." Due to the dilution of the discharge, there was immediate cessation of the destructive process. "This continuous irrigation was continued for 5 days and nights." Leakage soon stopped and recovery occurred.

Case 18. Gardner's (10) case: A fistula about the size of a lead pencil was found at operation between the fundus of the gall bladder and the duodenum. A stone was "milked out" of this fistulous tract. The gall bladder, which had been opened, was carefully closed. On the ninth day a foul, purulent discharge, which later excoriated the skin, appeared and persisted for about a month. The patient recovered. Gardner thinks that the duodenal discharge escaped by way of the gall bladder.

Case 19. Davis' (5) case: A small fistula existed between the duodenum and the kidney pelvis, about 1 square centimeter of the periphery of the duodenum being involved in adhesions. In doing a nephrectomy this fistulous tract was cut through. Its opening into the duodenum was too small to be readily found. The kidney incision was closed with ample drainage. "On the fourth day there appeared a profuse watery discharge," which irritated the skin bordering incision. Discharge gradually lessened and ceased by twelfth day. Healing eventually occurred.

Case 20. Palmer's (21) first case: A gastric resection of the Billroth II type was performed. The duodenal stump was closed with difficulty. On the eighth day, following a full meal by mistake, a fistula suddenly developed. Rapid and extensive digestion of the surrounding skin followed. "Immediately food was withheld by mouth; atropine and sodium fluorid, 1 grain, were given by mouth to inhibit pancreatic activity. Sodium fluorid, 1 per cent, was also used as a wet dressing over the abdomen and injected along the fistulous tract. Paraffin of low melting point was frequently and freely painted over the skin. The discharge of bile and pancreatic fluids ceased after 8 days." Six days later the wound and skin were thoroughly healed.

Case 21. Palmer's (21) second case: A common duct stone was removed by the transduodenal route. The duodenum was closed with three rows of No. 1 chromic catgut. A rubber drain but no gauze was inserted. On the sixth day, upon loosening the drain, a duodenal fistula developed; the drainage became very profuse and caused "rapid and extensive digestion of the skin of the abdomen in a few hours." Everything *per os* was immediately stopped except for medication. Glucose and sodium bicarbonate were given per rectum. Sodium bicarbonate was given *per os*. Atropine was administered for several days. Sodium fluorid was given *per os* in 1 grain doses and was employed in 1 per cent strength in an irrigating solution directed into the fistula. The abdomen was covered with paraffin. In spite of this the "quantity and irritability of the discharge increased. On two occasions the dressings were saturated with blood. On the twelfth day a No. 14 catheter was inserted to the depths of the fistula, through which a continuous drop irrigation of the tract with soda solution was carried out. This was continued until the patient's back became so sore through digestive action of the fluid running into the Kelly pad under him that it had to be discontinued" in spite of marked improvement. Later fluids were given *per os*, also large doses of liquid petrolatum to coat the fistulous tract. The fistula was frequently plugged with zinc oxide. Recovery eventually occurred.

Case 22. Einhorn's (6) first case: A duodenal fistula developed 17 days after an unsuccessful attempt at operation on a biliary fistula following a cholecystectomy. The patient complained of an intense itching and burning in the wound. The skin around the fistula became eroded. The discharge from the fistula contained bile, pancreatic juice, and food particles. Trypsin was tested for and found. The condition of the patient was serious. Two days later a duodenal tube was passed *per os*. It entered the duodenum 2 days later. Milk, lactose, and saline solution were then administered successfully through this tube. Within 2 weeks the irritated skin had cleared up and the discharge from the wound had diminished greatly. The duodenal fistula had closed 17 days later.

Case 23. Hendon's (16) case: A duodenal fistula developed in a patient upon whom a number of operations had been performed on the biliary passage. The gall bladder had been removed. An attempt was made to establish a permanent biliary fistula. A drainage tube was inserted into the wound and gauze packed around it. The next day the duodenal fistula was evident. The discharge was very profuse. "Oakum pads were used to absorb the discharge. The skin was protected with a rubber dam and the fistula was packed every day with gauze strips saturated with compound tincture of benzoin." The fistula closed within 5 weeks.

Case 24. Einhorn's (7) second case: Upon removal of a very adherent gall bladder severe hæmorrhage was encountered from the exposed liver tissue. Three gauze tampons were inserted to control the bleeding. The last

tampon was removed 3 weeks later, when it was discovered that a duodenal fistula was present. The fistula persisted for 5 months. At times the discharge was abundant, but the surrounding skin was not injured since no pancreatic juice escaped. There was very little bile discharged. A duodenal tube (44 inches long) was inserted *per os*; 2 days later jejunal feedings were started. Improvement was soon noticed. There was a discharge off and on, for a time, but the fistula closed eventually.

Case 25. McGuire's (19) case: The duodenum was torn into in removing the gall bladder in the presence of dense adhesions. This rent was closed with a double row of chromic catgut sutures. The common duct was drained by a tube, protective gauze and rubber tissue being placed about it. On the ninth day "there was a sudden and profuse discharge of gastric contents through the incision, evidently due to a duodenal fistula." Jejunostomy was performed. Water and nourishment were given exclusively by the jejunostomy. The result was immediate and gratifying. Spontaneous closure occurred in three weeks.

Case 26. Stadler's (23) case: A right upper abdominal abscess, which was secondary to a ruptured gall bladder, was opened. The cavity was drained with a Kocher glass drain and the incision wound with iodoform gauze. On the ninth day a high intestinal fistula developed. Five days later the fistulous tract was tamponaded with a strip of gauze dipped in olive oil. The tampon was changed every other day. The fistula closed completely in a little longer than a month.

Case 27. Koerte's (15) case: Due to a crushing injury the liver was lacerated. After suturing these lacerations the wound was tamponaded. A subphrenic abscess developed. A few weeks later a duodenal fistula developed. The next day blood escaped from the fistula. At operation a finger-sized opening in the duodenum was closed by suture and a jejunostomy performed. Death occurred 2 days later. Autopsy showed that death was due to peritonitis following the giving way of the suture line in the duodenum.

Case 28. Furtwaengler's (9) case: Five weeks after a blow on the abdomen a right upper abdominal quadrant abscess broke spontaneously to the outside. A duodenal fistula was present apparently at this time. Skin around the fistula became reddened. The patient failed rapidly. At operation, performed 2 or 3 weeks later, a duodenal defect, on the external curvature of the inferior flexure, was closed with three rows of silk sutures. Two-thirds of this suture line was on the serous side and one-third was retroperitoneal. In addition to this a posterior gastro-enterostomy and a pyloric occlusion were done. For 9 days there was no intestinal drainage; then bile suddenly appeared. Death occurred 4 days later from peritonitis, due to leakage of the duodenal suture line.

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AN INQUIRY INTO THE USEFULNESS OF THE DUODENAL TUBE[1]

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THE object of this research was to determine the clinical applicability of duodenal drainage to diagnosis and treatment of the duodenal and biliary tract lesions with special reference to gall-bladder and bile-duct infection.

HISTORY OF THE DUODENAL TUBE

The history of the duodenal tube can be traced back to Einhorn (8) who has devised many useful gastric instruments, and who in 1909 used the tube for feeding peptic ulcer cases as well as applying it clinically in diagnosis. The first serviceable duodenal tube was the Rehfuss (18) but since then many different types, Buckstein (4), Palefski (17), Lyon (13), etc., have been introduced.

It remained, however, for Lyon (14) first, to show the value of duodenal drainage for purposes of diagnosis and treatment in diseases of the biliary system. Following Lyon, there have been many who have tried to prove or disprove his claims. Wide controversy exists as to the efficacy of this method in the cytological, bacteriological, and chemical studies of the bile recovered by means of duodenal intubation; on one side, the method boasts of its champions, Lyon, Smithies (20), Friedenwald (11), Whipple (22), Stewart (21) and others; while on the other side there are the skeptics, Einhorn (9), Dunn and Connell (7), Cronn Reiss and Radin (5), Auster and Cronn (1), Bassler Lucket and Lutz (2), etc.

In this paper I propose to give an impartial report of the actual findings in my investigation of five hundred cases.

ANATOMY AND PHYSIOLOGY OF THE BILIARY TRACT

In order to understand the mechanism of biliary tract drainage, it will be necessary to review shortly the different parts of the biliary system and to describe its peculiar nerve supply.

Anatomy. The biliary system is composed of liver, bile ducts, gall bladder, and common duct. The liver is a constantly secreting organ, selecting certain substances from the blood, transforming them and returning some back to the blood stream while others are excreted in the form of bile. This specific excretion of the liver passes down a series of small ducts in the liver substance, which unite to form the hepatic duct, which in turn unites with the cystic duct to form the common duct. The common duct empties the secretion into the duodenum and is controlled at its terminal end by a sphincter muscle. The gall bladder is a pear-shaped sac possessing a strong fibromuscular wall which has the power of changing a constant flow of bile from the liver to the duodenum into an intermittent one. The gall bladder is placed between the liver and the common duct sphincter muscle. When the sphincter of Oddi is closed, the gall bladder acts as a buffer and stores up bile which becomes concentrated within its walls and is used when demanded for digestion.

Innervation of the gall bladder and bile passages. The innervation of the gall bladder was specially studied by Doyon (6) in 1894. He showed that the gall bladder had a double nerve supply, from the sympathetic and from the vagus; that the gall bladder received both inhibitory and motor fibers through the sympathetic, while in the vagus, there also occurred both motor and sensory fibers, motor fibers to the sphincter and inhibitory fibers to the gall bladder. The vagus is the motor and secretory nerve to the gall bladder and bile passage. The sympathetic deriving its fibers from the ninth right intercostal segment is the sensory nerve to the gall bladder; it is inhibitory to the muscular wall, but supplies the motor filaments to Oddi's sphincter. Thus stimulation of the vagus causes emptying of the gall bladder through a relaxed sphincter and filling of the lax walled gall bladder with bile. Doyon's work was later confirmed by Freese (10), Oddi (16), and Meltzer (15). Meltzer stated: "It seems quite safely established that the physiological discontinuous character

[1] This research was conducted during the tenure of the Hudson's Bay Company Research Fellowship, University of Manitoba, for one year, under the direction of Dr. William Boyd, Professor of Pathology.

of the flow of bile into the duodenum is regulated by a reflex mechanism dominated by the 'law of contrary innervation.'" In 1917, while working with magnesium compounds, Meltzer found that magnesium sulphate when placed in the duodenum would cause a completely local relaxation of the intestine and thus relax the common duct sphincter, permitting the ejection of bile from the biliary tract into the duodenum. Therefore, as this discharge of bile was due to reflex contraction of the gall bladder from a relaxation of the sphincter of the common duct caused by magnesium sulphate, it suggested to Meltzer that in cases of jaundice and biliary colic the local application of magnesium sulphate to the duodenal mucosa might be of great value in permitting the ejection of bile and the probable removal of a calculus of moderate size.

THE EVOLUTION OF DUODENAL DRAINAGE

Lyon, of Philadelphia, became interested in Meltzer's work, and from this he evolved the method of duodenal drainage in man. Lyon theorized that if the above "law of contrary innervation" was sound, then anything which caused an inhibition of tonus of Oddi's muscle, must necessarily cause a contraction of the gall-bladder musculature. This I have found to be not true, for such drugs as benzyl benzoate, atropine sulphate, etc., will cause an inhibition of tonus of Oddi's muscle allowing the ejection of bile, but will not produce expulsion of the dark or gall-bladder bile. On the other hand, magnesium sulphate does call into action this antagonistic reaction of duct sphincter and gall bladder. Magnesium sulphate, 33 per cent, was used in most of the cases, with good results following.

Whether magnesium sulphate is a specific agent in stimulating the flow of bile from the gall bladder, or whether Meltzer's law of contrary innervation is correct, or B. L. Knight's (12) suggestion that the laws of osmosis is responsible, it is not within the scope of this paper to discuss. Suffice it to say that a wide controversy does exist, which can best be judged by the extensive literature written on the subject, pro and con.

Duodenal drainage—a clinical aid. The duodenal tube permits of making direct observations on the bile obtained from the several sources of the biliary system. It can be easily demonstrated that the use of magnesium sulphate, locally, delivers bile through the duodenal tube in varying quantities and of varying quality. It does this when the duodenum is previously bile free indicating that the solution of magnesium sulphate does relax the sphincter of the common duct; furthermore, it can be noticed that the character of the bile recovered by the duodenal tube undergoes certain definite changes in color and viscosity: first a light yellow to a golden yellow; then a deeper, richer, more syrupy golden brown; and finally to a thinner, less syrupy golden yellow. I have found that this sequence occurs in practically all apparently normal cases.

TECHNIQUE OF EXAMINATION

The following was the procedure used in my series of cases:

1. The patient is instructed to take a light supper the evening before the morning that the treatment is to be given, nothing being allowed by mouth, except water, after 10 p.m.

2. Before retiring, the teeth are brushed thoroughly, the mouth cleansed, and the throat gargled with an antiseptic solution; this is repeated again in the morning.

3. The tip of a freshly sterilized duodenal tube, dipped in sterile glycerine, is placed in the back of the patient's mouth and patient is instructed to swallow and then breathe out and the tube slips down past the glottis easily. (Patients will sometimes stop breathing and they think that they are gagging.)

4. The tube is swallowed to mark 1, and the stomach is washed with warm sterile water. Potassium permanganate (1:12000), is not used any more to wash out stomach, because it nauseates most patients and consumes valuable time.

5. Patient is then ordered to turn on his or her right side, and swallow tube very slowly to mark 111, taking about 20 minutes to do so.

The bulb of the tube should enter the duodenum in 20 minutes. Sometimes its passage is accomplished in 5 minutes, but rarely does it take more than 1 hour. The presence of the bulb in the duodenum may be determined by:

a. Duodenal "tug." When a slight pull is made on the part of the tube that is hanging from the patient's mouth, a characteristic resistance is felt; this tug is not experienced when the bulb of the tube is in the stomach.

b. Character of the aspirated fluid. There is a change in the quality of the fluid from that of the stomach, it is alkaline in reaction, pearly gray or bile stained in color, more stringy in consistency and contains few flocculi.

c. The failure to recover immediately any fluid taken by mouth. Water poured down the tube, when the bulb is in the stomach is returned almost at once, but if the bulb is in the duodenum any fluid instilled therein will not be returned. This can be tested out with such fluids as broth, milk, or a colored fluid.

d. The fluoroscope lends itself as the best check on the position of the tube. A view can be taken of the tube alone, *in situ*, or a view after the injection of barium sulphate into the tube. This method, however, is not very convenient and can be used only where there is an X-ray apparatus.

6. Duodenal contents are then collected by means of gravity siphonage. Under normal conditions the common duct sphincter remains closed, and little or no bile is present in the duodenum. Specimen of duodenal contents can be examined for the presence of pancreatic juices.

7. When no bile is obtained, then 50 cubic centimeters of warm sterile magnesium sulphate solution, 33 per cent, are instilled into the duodenum, then returned by siphonage; when the gall bladder is atonic it is sometimes necessary to re-stimulate with more magnesium sulphate solution to secure a flow of bile.

8. A few minutes after the salt solution has been returned, the common duct sphincter becomes relaxed and bile appears at first mixed with magnesium sulphate, then clear bile. This first bile that appears, usually a light lemon yellow, is considered to be common duct bile and varies in amount from 10 to 25 cubic centimeters. This bile is then collected in a specimen bottle and marked specimen 1. Cultures are also taken directly from the tube into the agar and broth cultures.

9. Suddenly the bile changes color, becoming a deeper, richer, more syrupy, golden yellow or brown or green. This is the gall-bladder specimen and appears normally in amounts from 10 to 90 cubic centimeters. When this change occurs the specimen bottles are changed and new cultures taken; these are labelled specimen 2.

10. Soon another change occurs, the bile becomes lighter again and much thinner than the two previous specimens. This is the freshly secreted bile from the liver. Bottles are again changed, cultures are taken and these marked specimen 3.

After the three samples are recovered and the cultures taken, Ringer's solution, 250 cubic centimeters, is slowly injected into the duodenum to wash out any of the infected material that may have escaped into the bowel. This solution is not siphoned back but allowed to remain in the duodenum.

The tube is then withdrawn very slowly. A little water poured down the tube while it is being withdrawn will prevent any bile from being brought up into patient's mouth.

There should be no difficulty experienced in passing the tube, if the operator exercises enough patience and does not hurry the process. During the time that the tube passes from stomach to duodenum, it is well to distract the patient's mind from himself and the duodenal drainage. This can be done in various ways; for instance by allowing the patient to read some interesting book or to listen to an operatic record on the Victrola. One patient who was very excitable, became most restless when the tube did not enter the duodenum after one half hour and he asked for the telephone to enquire of his broker, how certain stocks were fluctuating; as soon as he got through talking, duodenal contents began to flow from tube. Another man to compose himself would smoke his pipe while waiting for the bulb to pass into the duodenum, and this invariably would cause a flow of bile from the tube.

EXAMINATION OF SAMPLES OF BILE RECOVERED

The samples should be examined as quickly after recovery as possible, otherwise changes occur which alter the findings somewhat. I have noticed on a few occasions that after

completing a drainage at a private home and then having to travel back to the laboratory to examine the specimens, probably one hour after recovery, specimens which came away turbid and flocculent from the tube would become clear and transparent with but few flocculi. This, however, is not the rule. Most samples of bile change color, becoming darker and more turbid on standing any length of time because of the precipitation of bile salts and bile pigments and in this way confuse the microscopic picture.

Gross examination. Valuable information is to be gained from direct observation of the bile and its manner of discharge, the quantity of bile ejected, the color, turbidity, reaction, viscosity, the presence of mucus and clear or bile-stained epithelium, in the different samples recovered.

Microscopic examination. The samples of bile are centrifugalized as soon as possible and the deposit is examined while wet, just as is a urinary sediment, for pus cells, epithelium, ova and parasites (lamblia intestinalis, fluke disease, etc.), crystals of cholesterin and lecithin, and micro-organisms.

Permanent slides were made in about two hundred cases, three different stains being used for each sample of centrifugalized bile. Certain cellular structures, I found, showed to better advantage with a particular stain. The micro-organisms showed up best when methylene blue was used; most of the cellular structures took the hæmatoxylin and eosin stains very well; while the leucocytes and degenerated pus cells showed to best advantage with Jenner's stain.

In preparing the permanent slides, the wet-fixation method was used:

1. Small amount of deposit of centrifugalized bile was smeared on a glass slide or a cover slip and heated in the flame until just the edge of the film became dry.

2. Cover slip or slide was then gently immersed in a saturated solution of mercuric bichloride (to which 5 per cent formalin had been added), for purposes of fixing, and kept there for 30 seconds.

3. The fixed smear was then passed through absolute alcohol, then washed in running water.

4. Smear was next stained with the selected staining solution, methylene blue; hæmatoxylin and eosin; Jenner's stain. (When Jenner's stain was used, distilled water was used for washing instead of tap water.)

5. Smear was then washed in water, then xylol and finally mounted with Canada balsam. Each slide was then labelled and put away for future examination or reference.

PRESERVATION OF CELLS

As duodenal contents are a digestive juice, it was thought that digestion of the cells might take place which would alter the findings if the specimens were not examined on immediate recovery. To determine this a series of samples were tested out as to the preservation of their cytological content after 24 hours, 48 hours, and 72 hours, both at room temperature and when kept in the ice chest.

After 24 hours the cells were just as well defined but the field was more taken up with bacteria and yeasts; after 48 hours the cells were still quite definite but did not take the stain so well and were almost hidden by the extra number of bacteria and yeasts; after 72 hours some smears showed only clumps of organisms and yeasts, the cellular structures being either completely lost from the picture or very poorly defined. These samples were divided into two lots: one left at room temperature and the other kept in the ice chest, but no appreciable difference in the cytological content of the two lots was noticed.

Bacteriological examination. Three cultures on three different media were taken of each sample of bile. These were incubated for 24 and 48 hours, then examined and the organisms, if present, identified. Plain agar, bouillon, and blood serum, were the different media used. The last mentioned was later discarded because it was completely digested by the bile.

NORMAL APPEARANCE OF BILE AND DUODENAL CONTENTS

Before applying this method of drainage in the diagnosis and treatment of lesions biliary or duodenal, a knowledge of the normal appearance of bile and duodenal contents is

important. To gain this, a number of hospital patients with no apparent digestive disturbances were tried out as normal cases. Duodenal contents normally are free of bile, alkaline in reaction, pearly gray, fairly transparent, syrupy, stringy in consistency and contain few flocculi. In my series of normal cases, few samples of duodenal contents were not bile-stained. This I think was due to the presence of the bulb of the tube in the duodenum, acting as a foreign body and causing a relaxation of the normally closed common duct sphincter and ejection of bile into the duodenum. Bacteriologically, the duodenum was practically free from organisms, the bacteria most commonly encountered were gram-positive cocci and gram-positive bacilli.

Normal bile contains water, bile salts and bile pigments, cholesterol, lime, and neutral fats. The bile as it is obtained normally undergoes certain definite changes in color and viscosity. After being assured that the bulb of the tube is in the duodenum, magnesium sulphate, 33 per cent, is instilled, then allowed to return, and this is followed by a flow of bile. The normal flow of bile was found to be from 15 to 30 drops per minute. At first the bile is light lemon yellow to golden yellow in color, clear, no flocculi, amount 10 to 20 cubic centimeters, then there is a sudden change to a golden brown bile, syrupy and thicker than the first, rather opaque, no flocculi, amount 30 to 60 cubic centimeters, then a third change, the bile becoming thinner and lighter in color again, a golden yellow. Microscopically, the centrifugalized specimens of bile are free from pus cells, contain few epithelial cells, bile salts and crystals. Bacteriologically, no pathogenic organisms are observed. Chemically, bile is alkaline in reaction, contains biliary salts and biliary pigments.

FAILURE OF THE DUODENAL TUBE TO RECOVER BILE

The failure to recover samples of bile for analysis by means of the duodenal tube, may be due to a functional or a truly organic cause. Functional causes may be one or more, as nervousness, nausea, or pylorospasm. Extreme nervousness on the part of the patient, who has a drainage for the first time, does not allow the bulb of the tube to pass out of the stomach. The presence of a foreign body in the mouth (as the rubber tube), will often cause the patient to become very nauseated and the tube will be vomited up each time its passage is attempted. Pylorospasm is sometimes encountered and the bulb of the tube cannot enter the duodenum; when pylorospasm is present it is best to withdraw the tube and repeat the drainage at another time. I have not resorted to the use of atropine sulphate to overcome the pylorospasm in any of my cases, and have been successful in gaining an entrance to the duodenum by exercising a little extra patience or repeating the drainage a few days after.

An organic cause, however, might be responsible for the failure of the tube to enter the duodenum, as for instance, a tumor at the pylorus or adhesions from a healed pyloric ulcer causing obstruction of the pyloric canal, or in a case of visceroptosis, where the tube curls itself inside the stomach because it cannot travel up to the duodenum. This difficulty has been overcome at times by changing the patient's posture. Placing a pillow beneath the hips and raising the foot of the bed so that the patient's head is slightly lower than his hips has been found to aid the tube materially in its passage through the pylorus.

When one is assured that the bulb of the duodenal tube has passed through the stomach and is in the duodenum, and when, after repeated stimulation with magnesium sulphate, no bile is obtained, then the cause is common duct obstruction from stone or new-growth in the neighborhood of the common duct. In my investigation, two cases of carcinoma at the head of the pancreas involving the common duct (confirmed by autopsy), and one case of common duct obstruction by stone (confirmed by operation), were diagnosed beforehand with the aid of the duodenal tube.

INTERPRETATION OF DUODENAL FINDINGS

The samples of bile can be readily segregated as coming from the different parts of the biliary system and labelled accordingly. Each part can then be examined independently for infection of that part from which it came.

Common duct bile. Common duct bile exceeding 25 cubic centimeters suggests local stasis; if the bile is turbid, specific gravity greater than 1015 (before using magnesium sulphate), exhibits gross blood, crystals, calculi, flocculi of mucus or epithelium, and microscopically shows pus and desquamated epithelial cells, it means duct disease or cholangeitis. Catarrhal jaundice can be diagnosed by this means and is also amenable to treatment with the tube. Infection of the ducts, however, is usually a co-existent condition with some gall-bladder, liver, pancreatic, or duodenal disturbance.

Gall-bladder bile. The gall-bladder bile or second specimen varies in color from a dark greenish yellow, green brown, green pea, dark green to black. There has been much comment as to the source of this darker bile, whether it is from the gall bladder or the liver. In my opinion, this bile actually comes from the gall bladder, although there is probably mixed in with it some bile from the liver and the bile ducts, based on the following reasons:

1. According to Rous and McMaster the gall bladder exerts a most remarkable concentrating effect on the bile that passes through it; the color and viscosity of the second bile indicating a higher concentration, strongly suggests then that this bile comes from the gall bladder.

2. One function of the gall bladder is that of absorption (Boyd, 3). The daily excretion of bile from the liver, it is said, is as much as the excretion product of the kidneys, that is 1500 cubic centimeters, part of which is stored up in the gall bladder where absorption of the water (Rous and McMaster, 19) and cholesterol (Boyd) takes place, but in the diseased gall bladder the mucosa loses this power of absorption and the gall bladder distends to make room for the excess volume of bile that it is called upon to store. The gall bladder has the power to expand from its capacity of 1 ounce to that of 6 ounces. This, then, accounts for the 2 to 6 ounces of dark bile that is sometimes recovered from somewhere between the sphincter of Oddi and the liver.

3. In patients who have had their gall bladders removed and later come under my observation, the dark concentrated bile has not been ejected from the tube (except on one occasion), the color of the bile passing from the light lemon yellow or duct bile to that of the thin limpid, golden yellow bile of the liver.

4. In patients who have had their gall bladders removed, the contents of the gall bladders excised has proved to be identical with that dark bile recovered before operation (by means of the tube), for cellular structures and micro-organisms.

5. In patients suffering from clinical gall-bladder disease, treatment by duodenal drainage has showed a marked improvement in the patient's condition and the impression of an infected bile is changed to that of a normal bile.

The failure to obtain gall-bladder bile following the clear light yellow bile, after repeated attempts at different intervals, indicates obstruction of the cystic duct, due to stones, adhesions or pressure from without by a tumor in the neighboring viscera. Spasm of the small muscular band at the opening of the cystic duct into the common duct will not allow gall-bladder bile to be emitted, but if the drainage be repeated after a short interval of a few days, gall-bladder bile can be recovered, giving the patient relief and not allowing a wrong diagnosis of cystic duct obstruction to be made. Cystic duct obstruction due to some organic cause should not be diagnosed on a single drainage but a second duodenal intubation should be done to confirm the first findings.

An excess of gall-bladder bile, that is over 90 cubic centimeters, suggests gall-bladder stasis, which is the forerunner of gall-bladder disease in all its forms. Stagnation of bile in the gall bladder offers an ideal culture media for infective organisms if they happen to be present in the blood stream. With the presence of stasis and infection, the necessary factors for gall-stone formation, there is a predisposition to cholelithiasis. Gall-bladder stasis is due to non-functioning gall-bladder mucosa together with a hepatic disturbance, and if this can be detected early (as it can by means of duodenal drainage), the condition can be treated and serious surgical gall-bladder disease prevented.

Besides noting the quantity of bile ejected in this gall-bladder specimen, additional in-

formation can be obtained from observing the gross changes, as foul odor, blood, pus, crystals, flocculi of clear or bile-stained mucus and epithelium; then the microscope and culture tube offer further evidence.

Liver bile. Thirdly, we get a sample of bile which is golden yellow and thinner than the first two specimens—the freshly secreted bile from the liver. This comes from the hepatic cells and ducts and shows definite changes if disease of those parts exists.

VALUE OF DUODENAL DRAINAGE

This method has been found to be extremely valuable in the differential diagnosis of abdominal disease, the negative findings being particularly useful in ruling out biliary tract infection. The following cases illustrate its value, (1) in the case of negative findings; (2) in disease of the ducts; and (3) in disease of the gall bladder.

1. Negative Findings

A patient, age 30, complained of soreness in right upper abdomen. Had three or four attacks of abdominal cramps which would last 3 hours or more. Pain not associated with vomiting or other symptoms. He had typhoid fever 10 years ago. Has lost weight and strength. Has poor appetite. Eating food sometimes dulls the pain. The clinical diagnosis rested between cholecystitis and perinephritic abscess. Duodenal drainage was requested by surgeon. Duodenal drainage was done and the bile was reported to be not abnormal. Operation elected was for perinephritic abscess, which was found and drained. In this case, an exploratory laporotomy was not necessary to discover that the gall tract was not the seat of the trouble.

A girl of 18 complained of severe spasms of pain starting in right hypochondrium and radiating all over abdomen. She also complained of always feeling "bilious." She had typhoid fever at the age of 9 and catarrhal jaundice with similar pains as now, 4 months ago. Symptoms and physical examination pointed strongly to gall-bladder disease, though her age was against it (Starr, of Toronto, claims that gall-bladder disease does not belong to advanced years but can be traced back to the age of 13 in many cases). Clinical diagnosis, then, was cholecystitis with an associated cholelithiasis. Duodenal drainage was asked for to confirm the diagnosis but instead of doing that, a report was sent back to the contrary, the bile being reported negative for any evidence of infection of the biliary tract. At operation, the gall bladder was found to be of normal size and color, no stones present and it emptied in good time with very little digital pressure. The appendix, however, was found to be the cause of the disturbance. It was drawn up into the position of the gall bladder, the tip of the appendix being found at the costal margin.

A woman, age 45, complained of constant pain in right side just below costal margin, belching of gas, distress after eating. On physical examination, there was revealed a large, palpable mass in right hypochondrium. Clinical diagnosis was cholecystitis. Duodenal drainage was done and bile was reported negative for any inflammation of the biliary tract. At operation, mass in right hypochondrium was found to be a hard and fibrous tumor the size of a plum in the rectus muscle. Gall bladder was found to be not abnormal.

Numerous other cases diagnosed clinically as gall-bladder disease, in which a pre-operative duodenal drainage was allowed, were reported as having no evidence of gall-tract infection and the duodenal drainage report was confirmed at operation.

2. Disease of the Ducts

In a case of choledochitis, pus cells will appear in all three specimens, but most abundantly in the first; it appears in the gall-bladder and liver specimens because these must pass through the infected area and in so doing they pick up some of the inflammatory débris. Duct disease seldom occurs alone, being associated as a rule with gall-bladder disease or a liver disturbance. Julius J. Selman found an accompanying infection of the biliary tract in a number of cases of diabetes and chronic pancreatitis. Many patients return to the surgeon a few months after cholecystectomy complaining of much the same discomfort as before the operation, due to the fact that there was a co-existent cholangeitis with the cholecystitis which could not be remedied by surgical interference. Cholangeitis can be diagnosed and is amenable to treatment by means of duodenal intubation.

3. Disease of the Gall Bladder

In the diagnosis of gall-bladder disease, the efficacy of this method has been proved. With the aid of the duodenal tube, suspicious clinical gall-bladder cases have been either confirmed or disproved. I will illustrate a few cases that came to operation following duodenal drainage, in which the pre-operative diagnosis was corroborated.

A patient, age 60, complained of pain in both sides of upper abdomen radiating around to back at the same level. Attack commenced 3 weeks ago and seems to be getting worse each day. He has had recurring attacks of indigestion for about 10 years. Attacks usually come on about 10 to 30 minutes after eating, but may come on at any time during the day or night, for no known cause. Patient has no hunger pain, he ridicules the idea of eating to relieve the pain. He has no vomiting unless self induced; feels better after vomiting; no occult blood in vomitus. Bowels always constipated. He has had bleeding hæmorrhoids for past 10 years; no tarry stools. Appetite always good until present attack. Slight jaundice present, no previous jaundice. Clinical diagnosis: carcinoma of the stomach. Duodenal drainage was asked for before exploratory operation to throw some light on the jaundice noticed in the patient's scleræ.

Duodenal drainage. The bile, or rather the bile stained duodenal contents flowed immediately upon patient turning on his right side. After instillation of magnesium sulphate solution, duct bile flowed, a golden yellow, clear, amount 20 cubic centimeters. Microscopically this bile was negative, there being no deposit on centrifugalization. Culture showed bacillus coli. Gall-bladder bile, dark green, flocculent and turbid, amount 50 cubic centimeters, deposit in centrifuge tube was one-quarter inch of frank pus; microscopically sediment showed desquamated epithelial cells and very numerous pus cells; culture from this specimen showed bacillus coli and streptococcus hæmolyticus. The liver specimen was golden yellow and clear, showing few epithelial cells and a few odd pus cells by microscope and bacillus coli by culture.

At operation the stomach was thoroughly explored and no evidence of malignancy was found: the gall bladder was enlarged and distended with pus. The gall bladder was removed. The contents of the gall bladder appeared to be identical with that second specimen recovered with the duodenal tube before the operation, containing desquamated epithelial cells and numerous pus cells, while a culture from the gall bladder yielded streptococcus hæmolyticus.

Ten cases of cystic duct obstruction from stone, diagnosed as such with the duodenal tube, were later confirmed by operation. A description of one typical case follows.

A woman, age 45, felt perfectly well until 6 weeks before admission to hospital. Since then, she has had three attacks of severe pain starting in the pit of the stomach and working round to the right costal margin. Pains are sharp and "knifey." She has belching of gas and sour taste in her mouth for about 2 to 3 hours after eating. There is definite tenderness over gall bladder and also in right iliac fossa. Duodenal drainage showed the duct bile to be light lemon yellow and clear, amount 30 cubic centimeters. Microscopically there was a small amount of débris, no cellular structures, no pus cells, numerous organisms, and crystals of various shapes. After repeated stimulation with magnesium sulphate solution, color of bile did not change at all, just becoming a bit cloudy. No dark bile was ejected from the tube. On microscopic examination, this specimen showed a few epithelial cells, no inflammatory débris, crystals, and bacteria. Culture of both specimens showed staphylococci. On removing the duodenal tube, there seemed to be something holding it back; when tube was finally withdrawn, there was found a knot in it just 2 inches from the bulb. A report was sent to the surgeon that no gall-bladder bile had been recovered due to cystic duct obstruction, probably by a stone. At operation a few days later, gall-bladder walls were found to be thickened and the cavity packed full of stones. Cystic duct was completely obstructed; there was no bile in the gall bladder.

THE BILIARY TRACT AS A HIDDEN POCKET OF INFECTION

As a clinical aid in the detection of hidden foci of infection, in case of arthritis, neuritis, etc., the duodenal tube has proved to be of great assistance in locating the seat of the trouble in the biliary tract. Two interesting cases illustrating this follow:

A man, age 55, had typhoid fever 30 years ago, not severe, no complications. He had no other illness except measles in childhood. Twenty-five years ago, he had frequent attacks of tonsillitis. He is subject now to occasional attacks of backache, but has never been in bed for more than 2 days at one time. He has noticed a little stiffness across the elbow joints for the past 8 years, while 6 years ago his knee joints became slightly affected. About 2 months before his admission to the hospital he started with massage every second day and got progressively worse until he became bedridden and could not move any of his joints.

Examination revealed, height 5 feet 10 inches, weight 250 pounds (usual), all large joints swollen, smooth and shiny, swelling symmetrical, joints spindle-shaped. Heart very much enlarged, no endocarditis lesion present, had been on digitalis. X-ray showed evidence of gall-bladder pathology.

Duodenal drainage showed duct bile to be light green, turbid, and flowed until 50 cubic centimeters were collected before it changed to a dark green, flocculo-purulent bile, the gall-bladder bile, amount 120 cubic centimeters, then became light yellow and slightly cloudy, the bile from the liver. Small amount of pus cells were found in the first and third specimens, but the second specimen contained a large amount of inflammatory débris, numerous pus cells and numerous degenerated cellular structures and bacteria. Cultures of first specimen produced bacillus coli; second, bacillus coli, staphylococci and streptococci; and the third, bacillus coli. Duodenal

drainage showed the gall bladder to be a pocket of pus harboring bacillus coli, staphylococci, and streptococci.

As surgical interference was contra-indicated, patient was subjected to non-surgical drainage of the biliary tract; every second day and every third day was given an injection of autogenous vaccine made from the organisms in the gall-bladder bile. Patient's condition improved remarkably. After 2 months, drainage was reduced to twice a week for a period of 2 months, then once a week and once a month and now once in 3 months, just to keep a check on his condition. The bile cleared up of all its inflammatory débris and now appears to be normal in every respect. Today the patient walks to and from his office, climbs up and down the stairs without any difficulty, and outside of a little stiffness at times, claims that he feels fine.

Another interesting case of a hidden focus of infection was that in a young man suffering from retrobulbar neuritis. His teeth and tonsils were removed, sinuses in his head curetted without any improvement in his vision. Other examinations proved futile in locating the source of the trouble, and patient's vision was getting less each day. Duodenal drainage was asked for as a last resource. Duodenal contents contained great flakes of mucopurulent material. After magnesium sulphate solution was instilled, bile flowed a canary yellow, turbid and flaky. Microscopically, the sediment showed large amount of inflammatory débris, desquamated epithelial cells, numerous pus cells, bacteria. Bacteriologically, staphylococci and diplococci (gram-positive). This diagnostic drainage established the hidden focus of infection in the biliary tract, and patient's vision was increased 8 feet laterally a few days after this initial drainage. Duodenal drainage treatment was instituted at weekly intervals and the cellular content of the bile became clear and free from infection.

FURTHER USES OF THE DUODENAL TUBE IN DIAGNOSIS

Typhoid carriers. As a method of detecting typhoid carriers or determining whether a typhoid convalescent harbors the bacilli in his gall bladder or bile ducts, the tube has been found to be exceedingly helpful.

Parasites in the duodenum. The duodenal tube was used to good advantage to determine the presence of parasites or their ova in the duodenum or the biliary tract. It was by this method that Professor William Boyd, of the University of Manitoba, Pathological Department, was able to demonstrate the lamblia intestinalis, isolated from the duodenum of a typhoid convalescent. In one other case outside of the hospital, I was successful in discovering the lamblia in bile recovered by means of the tube.

Pancreatic ferments. The presence or absence of pancreatic ferments in the duodenal contents can be readily demonstrated with the duodenal tube and the use of Einhorn tubes. This study was not entered into in this work.

THERAPEUTIC USE OF DUODENAL TUBE

Many cases of clinical gall-bladder trouble have been relieved and the symptoms entirely alleviated by means of duodenal drainage and lavage. Such conditions as biliary stasis, atonic gall bladders that cannot empty themselves, the indeterminate chronic biliousness with severe headache, etc., have responded most satisfactorily to this treatment. The early stages of catarrh and infection of the biliary tract are most amenable to this treatment. Few cases have had only one treatment and have had no recurrence of their original trouble (18 months); others have a treatment at periodic intervals of 8 or 10 weeks, and in this way are relieved completely of their bilious attacks. The tube has also proved its great value in the treatment of hidden foci of infection located in the biliary system.

CONCLUSION

In my investigation five hundred cases have been studied. I feel satisfied to report that duodenal drainage is a helpful clinical method in the diagnosis and treatment of early diseases of the biliary system.

The whole procedure can be carried out in 1½ hours (average) and the patient does not suffer any inconvenience or discomfort; there are no after effects and the patient is free to get about and attend to his duties after the treatment.

Cases of suspected gall-bladder lesions that have come to operation have had the preoperative duodenal drainage diagnosis definitely confirmed. It will not be long before this method will be recognized in hospital and private practice as a necessary measure in the differential diagnosis of abdominal disease.

It presents an important means of determining the presence of parasites and their ova or focal infection of the biliary tract, conditions which may be of the greatest diagnostic

and therapeutic value in obscure conditions, such as arthritis, neuritis, etc.

Therapeutically, the method has proved to be extremely valuable in the early stages of catarrh and infection of the biliary tract, biliary stasis, chronic biliousness, and severe migraine. The duodenal tube cannot, by any manner or means, supplant surgery, where gross pathological lesions exist, such as cholelithiasis, empyema of the gall bladder with cystic duct obstruction or gangrene of the gall bladder, but where surgical interference is contra-indicated, because of a heart or kidney complication, the tube offers an alternative which in not a few cases affords much relief. In cholecystectomized patients who still complain of trouble in the right hypochondrium, the tube has been very useful in clearing up the stasis and infection, which could not be treated surgically.

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ACTINOMYCOSIS OF THE HEAD AND NECK

A Report of 107 Cases[1]

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ACTINOMYCOSIS of the head and neck is probably the most commonly overlooked pathological condition occurring in this region, as has been borne out by our experience in the Clinic. During the last 10 years, from 1913 to 1922, inclusive, 157 patients with actinomycosis have been examined at the Mayo Clinic. In 107 of these (68.1 per cent), the disease involved the head and neck; but in only 7 of this group were the patients receiving treatment for actinomycosis at the time of their examination. Some of the patients, however, had not consulted a physician. The recognition of actinomycosis of the head and neck in the Clinic has gradually increased from 2 cases in 1913 to 20 in 1922. During the last 3 years, 6 patients with primary actinomycosis of the tongue, and 2 with actinomycosis of the nasopharynx have been examined; we had not previously recognized the disease in these regions. Ninety-eight of the 107 patients were males. The age incidence was as shown in Table I.

The infection, as has been noted, is much more common in males than in females. The disease may appear at any period, from early childhood to old age. Our youngest patient was 9 years of age, and the oldest, 66. As is shown in Table I, the majority of patients were in early adult life, and almost 70 per cent of them were between the ages of 21 and 50 years. The activity of the disease bears no relation to the age of the patient.

LOCATION

The statistics of various authors differ as to the comparative incidence of involvement of the various regions, although all agree that the cervicofacial group makes up the majority. Von Baraçz, in 1903, reported 60 cases, 86 per cent of which involved the head and neck. In McKenty's series of 37 cases, 51 per cent are in the cervicofacial group. Our series of 107 cases comprises 68.1 per cent of the total of 157 cases examined at the Clinic. The primary site of the infection is shown in Figures 1 and 2, but the entire area infected is not always indicated, as often many areas were involved in the same patient. It is of interest that we have observed 6 cases of actinomycosis of the tongue in the last 3 years, and that only 35 cases were found recorded in the literature up to 1922. A more careful study of lesions of the tongue will probably disclose a larger series.

METHOD OF INFECTION

A consideration of the origin and mode of infection of actinomycosis in man has formed the basis for a great deal of investigation. It has been generally believed that the most common means of infection is by direct contagion from the lower animals. In taking the history of a patient suspected of having actinomycosis, we always inquire regarding the existence of lumpy jaw in cattle in the neighborhood. The presence of this condition probably indicates that the organisms are abundant on the vegetation of the locality, rather than that diseased animals are the primary cause of the infection in man. Transmission of the infection from the lower animals to man has been questioned. Leith denies this possibility, and it seems that this method of infection is less common, if it does exist, than was formerly believed. The 2 cases reported by Ochsner, so often cited as proof of direct infection, would seem to be little more than suggestive. Data with regard to 89 of the 107 patients in our series were obtained by means of questionnaires, and the question with regard to exposure to animals infected with actinomycosis was answered by 80. Of this number, 45 (56.1 per cent) had not, to their knowledge, come in contact with the disease in animals. The remaining 35 patients (43.7 per cent) had been more or

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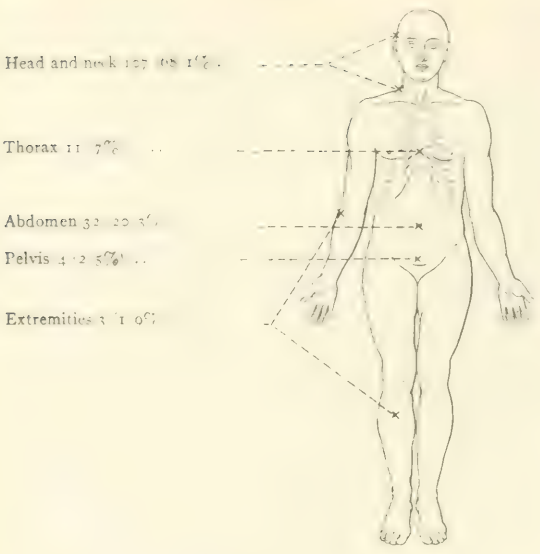

Fig. 1. Primary location of the disease in 157 cases.

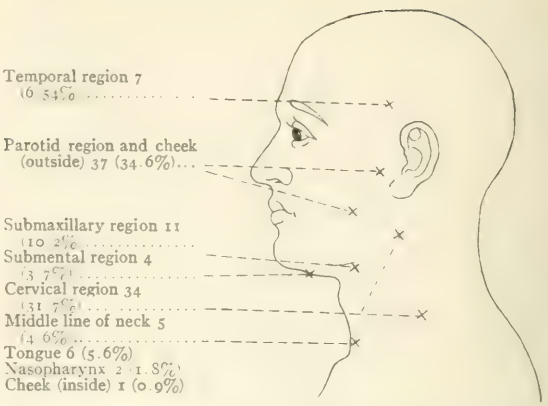
Temporal region 7 (6.54%)
Parotid region and cheek (outside) 37 (34.6%)
Submaxillary region 11 (10.2%)
Submental region 4 (3.7%)
Cervical region 34 (31.7%)
Middle line of neck 5 (4.6%)
Tongue 6 (5.6%)
Nasopharynx 2 (1.8%)
Cheek (inside) 1 (0.9%)

Fig. 2. Primary location of the disease in head and neck, in 107 cases.

less closely associated with the disease in animals previous to the onset of their symptoms. In all but 7 of these, the time that had elapsed from the exposure of which they were cognizant and the onset of the symptoms varied from 6 months to 25 years, an average of 5⅙ years. These 7 patients said that there had been lumpy jaw among their own cattle, or in the neighborhood, within 3 months of the onset of their complaint. A few of them had treated the lesions of the infected animals. Other facts, however, such as the presence of dental caries, picking decayed teeth with straws, or chewing bits of straw or grass were elicited in the history; thus, the probability of direct infection from cattle, even in this group of cases, is questionable. One of our patients with actinomycosis of the tongue had owned a cow with lumpy jaw 16 years before, but his symptoms were of only 6 weeks' duration. The nodule on his tongue, which was about 2 centimeters in diameter, had grown to this size from 0.5 centimeter in 3 or 4 weeks. Microscopic examination following the removal of the nodule revealed a foreign body within it, apparently a splinter of wood or a grain beard, the tip of which was surrounded by actinomyces. According to Harms, this finding has been made previously in 5 cases of primary actinomycosis of the tongue in man (Schortau, Fischer, Jurinka, von Baraçz [two cases]). It has been demonstrated a number of times in other tissues of the body, namely, in the mucous membrane of the mouth, tonsils, pharynx, lungs, intestines and external auditory canal. Bostroem, by studying serial sections of actino-

TABLE I.—AGE INCIDENCE

Age	Cases	Per cent
1 to 10 years	2	1.8
11 to 20 years	13	12.2
21 to 30 years	26	24.5
31 to 40 years	20	18.8
41 to 50 years	27	25.4
51 to 60 years	15	14.1
61 to 70 years	4	3.7
Total	107	

TABLE II.—OCCUPATION

	Patients	Per cent
Farmer	78	73.6
Laborer	9	7.5
Student	3	2.8
Clerk	2	1.8
Oil station manager	1	1.0
Meat cutter	1	1.0
Bookkeeper	1	1.0
Barber	1	1.0
Merchant	1	1.0
Stenographer	1	1.0
Tailor	1	1.0
Machinist	1	1.0
Miner	1	1.0
Cook	1	1.0
Locomotive engineer	1	1.0
Contractor	1	1.0
Chiropractor	1	1.0
Judge	1	1.0
Lumberman	1	1.0
Total	107	

mycotic lesions of the tongue in cattle, was able to demonstrate such foreign bodies in nearly all recent cases. In 5 of our cases there was a definite history of a foreign body. One patient said that he had not seen an animal with the disease for 25 years, but that 2 weeks before the onset of his trouble, he had gotten a barley beard in the floor of his mouth. Pain and soreness in this region had been followed by a mass in the submaxillary region. One patient thought he had had a rye beard in his throat, as he had a sharp, pricking sensation on one side of his throat; this was followed by a painful swelling of his neck a few days later. One patient had noticed a stinging sensation in his throat, after eating wheat, and a few days later, developed dysphagia, and a mass appeared on the side of his neck. One patient got a wheat beard in the right side of his throat, and 3 days later developed pain and swelling in the right submaxillary, cheek, and temporal regions. One patient had pain and dysphagia after injuring his tongue with a tobacco stem. In all of these cases the disease developed subsequently in the region that had been traumatized. This would seem to indicate a direct cause of the infection. Wright believes that such a foreign body probably does not introduce the infection, but merely creates an opening, permitting organisms normally present in the mouth to gain entrance into the tissues. It would seem that, if this were true, the organisms would be found entirely enveloping the foreign body, rather than surrounding the tip of it alone, as was noticed in our case. Lord has shown that these organisms occur in carious teeth and tonsillar crypts of persons who have no demonstrable actinomycosis, so that it is probably a rather

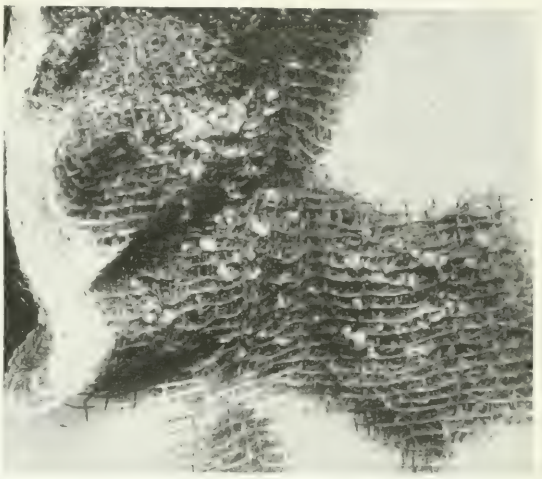

Fig. 3. (Case A346271.) Photograph of sulphur granules on a piece of gauze.

Fig. 4. (Case A325360.) Actinomycosis of the orbit, secondary to temporal region. Note the scarring in the temporal region and the exophthalmos of the right eye.

Fig. 5. (Case A203162.) Actinomycosis of the left temporal region.

Fig. 6. (Case A118952.) Actinomycosis of the nasopharynx, with involvement of the central nervous system. A hard mass was present in the left nasopharynx, with bilateral choked discs; the right 2 diopters, the left 1. The sixth nerve on the right was paralyzed. The symptoms were of 6 months' duration. Two months after the first examination a sinus appeared at the left outer canthus from which sulphur granules were obtained.

Fig. 7. (Case A359933.) Primary actinomycosis of the nasopharynx, simulating a malignant tumor. A hard mass, of 2 months' duration, was present in the left nasopharynx, bulging to the middle line. There was no external swelling. The tumor was clinically malignant. Two months later the cheek became involved secondarily, as shown in the picture.

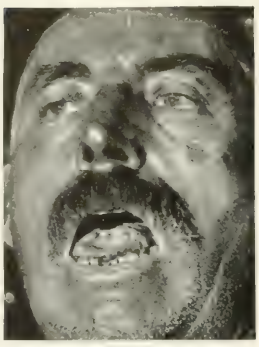

Fig. 8 (at left). (Case A411342.) Actinomycosis of the mastoid region. Note the sulphur granules in the discharge.

Fig. 9. (Case A374014.) Primary actinomycosis of the tongue, of the diffuse, hard type, involving the floor of the mouth; 2½ months' duration. Previous diagnosis of cancer, clinically.

common inhabitant of the normal mouth. The infection is not infrequently seen following dental procedures. In one of our cases it developed while the patient was being treated for pyorrhœa, in 6 it immediately followed the extraction of teeth, and in one, it followed the removal of tonsils. This patient had been attending an eastern girls' school. She had never been on a farm and had been in the country very little. One case of primary actinomycosis of the tongue developed immediately after biting the tongue. Four patients gave a history of an acute sore throat directly preceding the onset of their infection,

TABLE III.—GEOGRAPHIC DISTRIBUTION OF PATIENTS AT TIME OF INFECTION

Minnesota	18
South Dakota	16
Canada	15
Iowa	10
Montana	8
North Dakota	7
Wisconsin	5
Missouri	5
Indiana	4
Illinois	4
Nebraska	3
Ohio	3
Washington	2
Michigan	1
Kansas	1
Oregon	1
Oklahoma	1
Georgia	1
Colorado	1
Wyoming	1
Total	107

Fig. 10 (at left). (Case A416985.) Primary actinomycosis of the tongue. The nodule on the left margin of the tongue is of 1 month's duration.

Fig. 11. (Case A416985.) Low power photomicrograph showing a foreign body with actinomyces about the tip, which was found in the excised nodule from the tongue.

although this may have been the first manifestation of the disease.

In none of our cases was there evidence of direct transmission from one person to another. McKenty and von Baraçz have each reported one case which strongly suggests such transmission. Infection from milk or meat of diseased animals seems hardly probable, although one of our patients with primary actinomycosis of the tongue was a meat cutter, and Madyl reports a case of an inspector, who, while inspecting meat, frequently moistened his thumb with his tongue. He noticed a stinging pain on the area of the tongue where he had applied his thumb, and a few days later developed actinomycosis in this region. This meat, of course, was not cooked.

CLINICAL HISTORY AND FINDINGS

The clinical history of patients with actinomycosis of the head and neck depends on the virulence of the infection and the amount of secondary infection. The condition may occur as an acute phlegmon and the symptoms not differ from this. The most common symptoms are a stiffness in the region involved, pain, and swelling. The jaw may begin to tighten and become completely ankylosed. Pain in these cases is sometimes severe and throbbing, or it may be entirely absent until the mass breaks down. In certain cases dysphagia is an early symptom, especially if the base of the tongue or anterior cervical region is involved. In one of our

cases the dyspnœa was marked, because of involvement of the hypopharynx and epiglottis. Sore throat, stiffness of the neck, and earache are occasional symptoms. All types are seen, from a small recurring superficial abscess to extensive suppurating areas with multiple openings involving almost the entire half of the head and neck. The activity of the process varies from a slow, indolent condition which develops in the course of months or years, to a fulminating one of a few weeks' duration. The characteristic picture of an indurated mass which later breaks down, developing multiple superficial abscesses, is probably the most common. The swelling may be a small nodule below the skin or mucous membrane, or may be a fixed, diffuse, hard mass 12.5 or 15 centimeters in diameter. Breaking down of the involved area may occur in a few days, or the hardness may persist for months. In the cervical region the abscesses are usually elongated, superficial and multiple, and the skin over them, which is folded in linear striations, has a soft, doughy consistency.

Fig. 12. (Case A150862.) Actinomycosis inside the right cheek, posteriorly, at the margin of the jaw, of 3 weeks' duration.

DIAGNOSIS

The diagnosis of actinomycosis must be based on the clinical picture, the finding of the sulphur granule, and the microscopic demonstration of the actinomyces (Fig. 3). If the disease is in the tongue, or if there is a great deal of secondary infection, a diagnosis of actinomycosis must depend on detailed study of the tissue removed for microscopic examination. In a group of cases presenting the classical symptoms and clinical picture, a diagnosis is simple. A large number of the cases, however, are recognized with much more difficulty, and it is often necessary to keep the patient under observation for a time to corroborate the clinical evidence. If a fresh pocket can be opened, the sulphur bodies usually are easily demonstrated, but if there is a great deal of secondary infection, it is sometimes very difficult to obtain one for microscopic examination.

TABLE IV.—DURATION OF SYMPTOMS BEFORE EXAMINATION

Time	Cases
1 to 2 weeks	4
2 to 4 weeks	4
1 to 2 months	29
2 to 4 months	27
4 to 6 months	10
6 to 8 months	9
8 to 10 months	5
10 to 12 months	7
1 to 2 years	4
2 to 3 years	4
Over 3 years	2
Indeterminate	2
Total	107

In 43 cases, 46.2 per cent of our series, a microscopic diagnosis was made within 2 days after the first examination. In 66 cases, 72 per cent of our series, it was made in 1 week, and in 72 cases, 77.4 per cent of our series, it was made within 2 weeks. In 21 cases the microscopic diagnosis was not made for a month to 6 weeks following the first examination, sometimes at a subsequent visit. Often treatment was instituted on the clinical evidence of actinomycosis, although this could not be corroborated microscopically. In 8 of our cases, in which a clinical diagnosis was made, we were not able to demonstrate the condition microscopically during the patient's stay at the Clinic.

The gross appearance of the granules is quite characteristic. As a rule, they are light

Fig. 13 (at left). (Case A405621.) Diffuse fulminating type of actinomycosis of the left side of the face and neck, of 3 months' duration, showing multiple sinuses.

Fig. 14. (Case A392156.) Actinomycosis outside of the left lower jaw. Classical location.

Fig. 15 (at left). (Case A367261.) Actinomycosis of the parotid region and lower jaw, a hard tumor of 1 year's duration, simulating sarcoma.

Fig. 16. (Case A299687.) Actinomycosis of the parotid and submaxillary regions. Note the new pockets forming in the parotid region.

yellow, and about 0.5 millimeter in diameter, although we have seen them in some of our cases whitish or dark gray. It is very essential that the physician who drains the phlegmon or explores the tumor should examine carefully for the sulphur granules and corroborate his diagnosis by microscopic examination. This will be much more satisfactory than simply saving pus from a drained phlegmon and referring it to the clinical pathologist for diagnosis. Sanford and Magath have recently discussed the laboratory diagnosis of this condition.

In Table V is a list of diagnoses which had been made in some of our cases, either before examination or at the Clinic before the true diagnosis was established.

Fig. 17 (at left). (Case A406422.) Actinomycosis of the cervical region simulating a branchial cyst sinus.

Fig. 18. (Case A406422.) Roentgenogram of patient in Figure 17. Bismuth which was injected into the sinus in the neck came out through the upper hole of the tonsil. The tonsil did not reveal actinomyces microscopically.

Actinomycosis may secondarily involve any part of the head and neck, and must be distinguished from many types of tumor in this region. The hard, fixed mass over the temporal region, of 3 to 6 months' duration, may be sarcoma, or actinomycosis. The subacute, subperiosteal abscess over the mastoid region

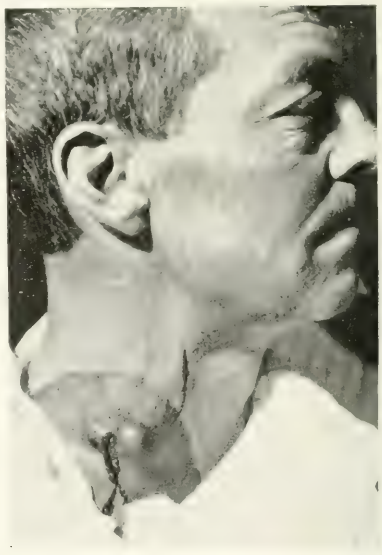

Fig. 19. (Case A406904.) Actinomycosis of the cervical region, simulating metastatic gland. A gland, showing clinical signs of malignancy, was removed from the anterior cervical region for diagnosis; it was reported inflammatory. Actinomyces were not looked for at that time. Later examination showed the condition to be actinomycosis. Sulphur bodies are shown in the discharge.

Fig. 20. (Case A357702.) Bilateral cervical actinomycosis of 10 months' duration, which was diagnosed tuberculous adenitis.

Fig. 21. (Case A354858.) Actinomycosis of both cervical regions and the back of the neck, of 1 year's duration. The diffuse hard masses were diagnosed malignant lymphoma.

and scalp may be a primary suppurative condition of the mastoid, or it may be actinomycosis. We have seen 2 patients with hard masses in the lateral wall of the nasopharynx, bulging to the middle line, with no other neoplasm of the head visible. These were clinically malignant, but both proved to be actinomycosis.

Actinomycosis of the tongue may simulate a deep seated cancer, an infected cyst, or chronic cellulitis. We have not seen actinomycosis of the jaw bone itself, but on account of the picture presented by the involvement of the soft tissues around the bone, forming a hard mass, it must be differentiated from a periosteal sarcoma.

A phlegmon, supposedly secondary to an abscessed tooth, may be actinomycosis. In the submaxillary and cervical regions, actinomycosis must be differentiated from a chronic phlegmon, tuberculous gland, malignant lymphoma, metastatic malignant glands, phlegmon, sinus from tooth or tonsillar infections, or an infected branchial sinus. Actinomycosis in the middle line of the neck has been diagnosed thyroglossal-duct sinus, cancer of the thyroid, and tuberculous thyroiditis, in three cases (Figs. 4 to 23).

TABLE V.—DIFFERENTIAL DIAGNOSIS

Retro-orbital tumor
Malignant mass in temporal region
Subperiosteal abscess of scalp and mastoid region
Nasopharyngeal tumor, malignant
Infected cyst of tongue
Cancer of tongue
Tumor of base of tongue, malignant (?)
Sarcoma of upper jaw and parotid region
Osteomyelitis of lower jaw
Chronic phlegmon of submaxillary region, secondary to extraction of teeth
Phlegmon of cheek, secondary to pyorrhœa treatment
Chronic phlegmon of cervical region, secondary to tonsillectomy
Bilateral cervical adenitis, secondary to "flu" (?); malignant (?)
Chronic indurated cellulitis of neck
Carcinoma of cervical region, recurring
Tuberculous adenitis
Bilateral malignant lymphoma of the neck
Thyroglossal duct sinus
Tuberculous thyroiditis
Cancer of thyroid

TABLE VI.—END RESULTS

Patients			107
Patients traced			93
Not included			8
Meningeal involvement at the time of examination	6		
Diagnosis only; no treatment	1		
Death from cancer which developed on actinomycotic scar	1		
			85
Condition of 85 Patients Traced		Patients	Per cent
Well 5 years or more	9		
3 to 4 years	2		
2 to 3 years	5		
1 year	11		
Less than 1 year	9		
Time not stated	24		
		60	70
Dead		7	8.2
Under treatment		18	21
		85	

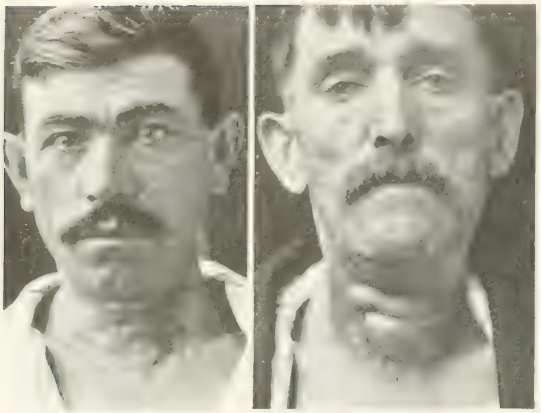

Fig. 22 (at left). (Case A360908.) Actinomycosis of the middle line of the neck, showing fixed mass in the region of the thyroid. The scars are of a previous operation for "cancer of the thyroid."

Fig. 23. (Case A409278.) Actinomycosis of the middle line of the neck, œdema of the pharynx and larynx, a hard, diffuse mass extending from the submental region to the manubrium, with fluctuant areas, secondary œdema of the hypopharynx and larynx, with some obstruction. Two months' duration.

With meningeal or chest involvement, additional differential problems are brought up. Moersch has reported the cases of actinomycosis of the central nervous system that have been seen at the Clinic.

TREATMENT

The most important factor in obtaining good results in the treatment of actinomycosis is an early diagnosis. In the early cases the patients all do well; we have not seen such patients become progressively worse during treatment. In advanced cases, however, with extensive involvement of the head, intracranial extension may develop, or in cases of extensive supraclavicular or cervical masses, the chest may become involved in spite of treatment. Treatment is empirical. The internal administration of copper sulphate has not proved markedly effective. Arsenic was formerly used, but its good effect was apparently due to its general systemic action. The iodides are almost specific. Mercuric chloride, phenol, tincture of iodine, and so forth, each has been injected directly into the masses, but each has been discarded. Roentgen-ray treatment is used; McKenty, however, believes that it is distinctly harmful.

TABLE VII.—DEATHS

Death probably due to meningeal involvement	2
Actinomycosis of temporal region and orbit	1
Death reported as due to anterior poliomyelitis and paralysis of respiratory system	1
Deaths probably due to involvement of the chest	3
Huge mass in cervical and supraclavicular regions; positive roentgenograms of chest, probably actinomycosis	1
Masses in bilateral, cervical, and supraclavicular regions, and in back of neck	2
No data regarding cause of death	2
	7 (8.2 per cent)

Recently radium has been used a great deal, and has proved very beneficial in causing a breaking down of the granulomatous masses and clearing up the induration. Surgery is a definite aid to medical treatment. The procedure we have found of most value is the opening up widely of all pockets, and packing them with iodoform gauze so that the entire area of the pocket is exposed to the air. The pockets are dressed daily, using iodoform gauze and swabbing the wound with iodine. Radium treatment is used in all cases and is repeated, as a rule, about once every 3 or 4 weeks. If the mass is hard and indurated, with no fluctuant areas or sinuses, radium is applied over the surface with 2 millimeters of lead screening, and an inch of wood distance, using from three thousand to six thousand millicurie hours in this way. This will often break down the masses and allow them to be drained. The radium also seems to block lymphatic drainage. Since we have used this treatment, none of our patients, except in the most advanced cases with masses in the supraclavicular region, has developed extension to the chest. We have also used saturated solution of potassium iodide, starting with 10 drops three times a day, and increasing it 1 or 2 drops a dose until 200 drops three times a day are being taken. If any evidence of iodism is noticed, the iodide is discontinued for a day or two, and then resumed at the same dose. After reaching 200 drops three times a day, the patient discontinues the treatment for a few days or a week, and then starts in

again at 10 drops. By this method we have cleared up the condition in practically all of our cases except the advanced ones, in which, on account of the proximity to the skull or the chest, the infection has extended to the meninges or the thorax.

CONCLUSIONS

The clinical picture of a rapidly growing, malignant tumor may be so closely simulated by actinomycosis that a clinical diagnosis of such a tumor should be guarded.

A tumor or gland of the head or neck which is clinically malignant, but does not prove so microscopically, is usually actinomycotic, and further study of the tissue may demonstrate this.

The finding of a sulphur granule on exploring a tumor, draining a phlegmon, or curetting a sinus of the head or neck, frequently clears up many indeterminate diagnoses.

A reduction in the mortality of the disease depends on its early recognition and the institution of proper treatment.

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A CLINICAL STUDY OF RADIUM THERAPY IN CARCINOMA OF THE RECTUM

By HOWARD A. KELLY, M.D., F.A.C.S., and GRANT E. WARD, M.D., Baltimore

THE whole cancer situation has undoubtedly been vastly improved by the advent of radium. This dictum applies to the treatment of rectal cancer in particular, but at best the therapy in this field is still both difficult and often disappointing. From the radiologist's standpoint we encounter the same obstacles which hinder the surgeon, namely, the difficulties of approach to the seat of the disease and the late symptoms, often rendering early diagnosis impossible and bringing us cases too far advanced for any hope of cure and, indeed, too frequently with but little hope of palliation, not to mention, too, the frequent cases treated for hæmorrhoids with the loss of precious time while the disease is advancing. Therefore, as things are, if we can only measurably relieve some of the hopeless, comfortably prolong the lives of others, and cure any appreciable percentage of cases, we are realizing a therapeutic triumph. This in fact we are able to do with radium in proper dosage, accurately applied, with efficient applicators. As knowledge increases with experience and we understand better the action of radium on the tissues and are able to learn why some tissues respond while others remain resistant, and as improvements are made in applicators and methods, it is also to be expected that the measure of relief afforded will be greater and the percentage of cures perceptibly higher.

METHODS OF APPLICATION

Before reviewing the cases we have handled, we desire to describe first of all the methods of application of radium emanation in use in the Kelly Hospital in the treatment of rectal carcinoma. There are available here, as in other regions of the body, three procedures, named in the order of their therapeutic value: (1) implantation of bare emanation needle points into the disease; (2) direct application of the emanation to the diseased area; (3) external or so-called deep radiation, with massive doses at a distance and fired into the diseased area from several directions.

1. The technique of the implantation of needle points carrying the emanation is that described by Neill in his article entitled, "Further Treatment of Bladder Tumors," in the *American Journal of Surgery*, December, 1920. The tiny glass capillary capsules carrying from 0.5 millicurie to 1.5 millicuries are inserted or, as we say, "threaded" into the end of a long needle, shown at *E*, Figure 1. With the patient in the knee chest posture, a Kelly proctoscope is inserted, the diseased area exposed and cleansed, and the needle then plunged directly into the growth, preferably near its periphery, under the control of sight (Fig. 2); the glass point is then thrust out of the end of the needle into the tumor, where it remains indefinitely if it does not come away with a separating slough. The number of needle points thus inserted in an individual case naturally depends upon the size and extent of the growth and its get-at-ability. The rule is that one millicurie of emanation will destroy one cubic centimeter of tumor tissue. While this method affords the most direct and intensive application and consequently the most efficient and economical dosage, it is most effective in the lower, more accessible parts.

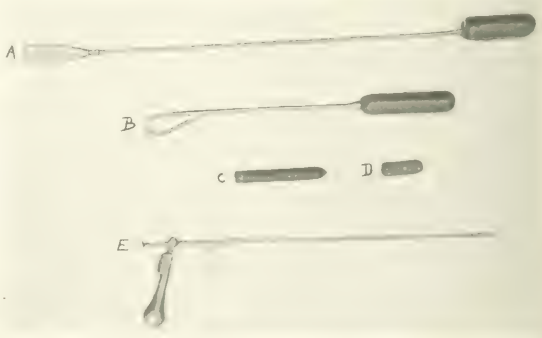

Fig. 1. Radium needle carrier, parts and assembled.

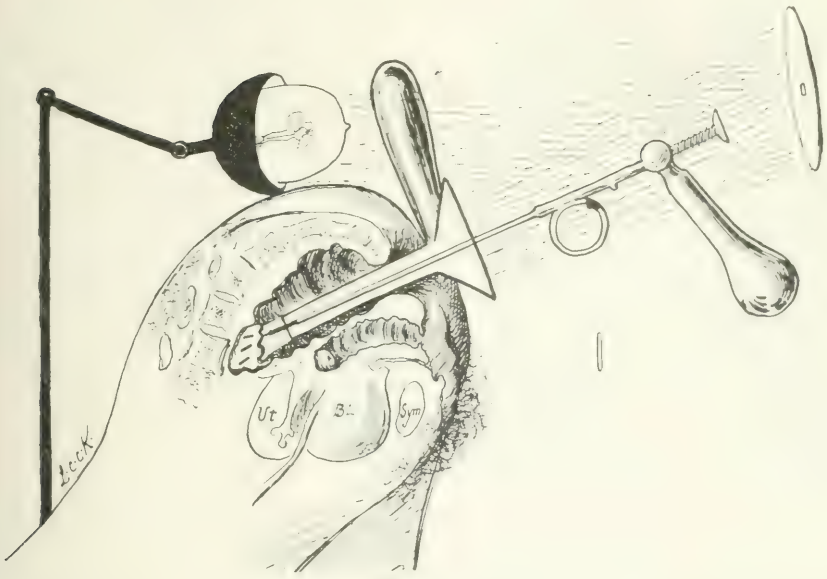

Fig. 2.

Fig. 3.

Fig. 2. Diagram illustrating the implantation of bare emanation needle points into the diseased tissue. The patient is represented in the knee chest posture with a Kelly proctoscope in the rectum. The needle carrying the emanation point is passed through the proctoscope into the growth. In the illustration three points are shown implanted. One is pictured in actual size at the right of the sketch.

Fig. 3. Radium applicator.

2. For the direct application through the rectum to the surface of the tumor, there are various applicators devised to fit the varying contours of the growth. For simple flat tumors a cloth applicator (*A*, Fig. 3) is best. The base of the applicator is made up of rather heavy gauze with several little pockets, each slightly larger than a radium tube of brass (*B*, Fig. 3), measuring 1 centimeter in length and 0.5 centimeter in diameter, which is pushed into it. The tubes are kept in the pockets by means of a purse string tied about the mouth. For filtration, various thicknesses of felt are sewed onto this gauze carrier. The size and shape of this applicator and the number of tubes contained will vary with the size and shape of the lesion; in each case, therefore, this is determined at the first examination and a drawing made to serve as a pattern. The application is effected through the Kelly cylindrical proctoscope with the patient in the knee chest posture. When the disease is extensive or high up or when for any reason the treatment is likely to be distressing, the contact with the radium can be secured with the patient in the dorsal posture. Sometimes we apply the radium after putting the patient under an anæsthetic. After setting the applicator in position, the adjacent normal mucosa is packed off and protected by lead filters or plain gauze or both. The filters, an important part of the technique, are small oval pieces of lead 4 by 2 by 0.5 centimeters, wrapped with gauze, to absorb the secondary rays and to render the filter more manageable (*C*, Fig. 3). (These applicators were first described by Burnam in the *American Journal of Roentgenology*, November, 1922, p. 769.) Where the growth is annular, a hard rubber finger-like applicator with a brass handle is excellent (*B*, *C* and *D*, Fig. 1). The thickness of the hard rubber may be 2 (*C* and *D*) to 4 millimeters (*B*). The applicator is cylindrical with a hollow center in which three or four radium tubes are bedded; when fewer tubes are wanted, the loaded ones are set in the distal end and blanks fill out the space. In this manner the radium is distributed all along a cylindrical growth. The charged applicator is inserted either through

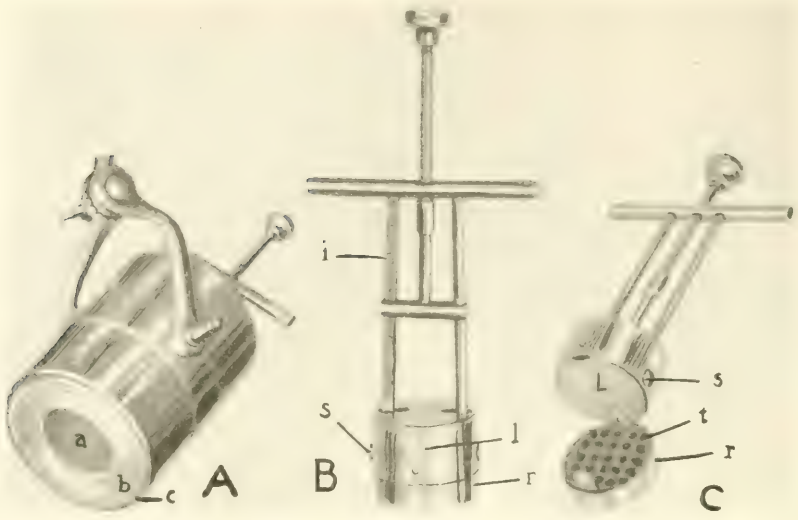

Fig. 4. A, Ward's lead cylinder used in giving heavy external radiation. The α-rays coming from the emanation tubes in the carrier within the cylinder emerge through the 2 inch portal, *a* and pass to the patient. *b*, One inch lead wall of the cylinder. *c*, The supporting collar of ⅛ inch brass. The cylinder is suspended over the patient by means of a car and crane and permits of focusing at any angle, allowing cross-firing of the tumor without irritating the skin.

B. Radium emanation carrier made to fit the inside of the cylinder. *r*, Box containing tubes of emanation; *l*, 1 inch of lead above box used to protect operator's hands; *i*, 1 inch scale on handle to indicate distance of emanation from skin of patient; *s*, brass stubs. These are forced against inner wall of cylinder by moving the central brass rod in handle upward, thus fixing the emanation at the desired distance from the skin.

C. Same as B but opened to show holes, *t*, for radium tubes.

the proctoscope, as above, with the patient in the knee chest or lateral posture, or preferably or more simply, with the patient in the lateral position, guiding the applicator with one finger in the rectum and omitting the speculum. The apparatus is held in place by fixing the brass handle to sand bags with strips of adhesive plaster. One or 2 gram hours is the dose commonly given.

3. For a heavy external application, thick lead cylinders with 2 or 3 inch portals are used (Fig. 4). The heavy lead prevents overlapping treatments and renders it possible to treat several areas, cross-firing the growth, at the same time avoiding injury to the skin. In this way as much as 1 or 1½ gram hours can be delivered to the heart of the disease without more than a slight erythema, while extensions of the growth or metastases in the glands are also reached. The areas of election are three or four over the sacrum and coccyx, one through the perineum, and (especially where the pelvic growth is extensive) the groins and suprapubic regions. If four areas are elected and the distance from the skin fixed at 3 inches, with a dosage of 10 gram hours over each area, we thus give a total of 40 gram hours, a substantial and effective dosage. This form of treatment with the internal radiations and implantations, make it possible greatly to reduce large tumors of the rectum and to relieve for years as well as to cure a definite percentage of cases. Using these methods we see some rectal irritation but no serious reaction. We have noted rectal irritation in 13 cases, in but 2 has there been any bladder disturbance. In 10 cases there has been post-radiative scarring or stricturing.

REVIEW OF CASES

In the series before us we include every patient who has entered our hospital with a diagnosis of primary carcinoma of the rectum and treated with radium either alone or in

combination with operation, from December 10, 1911, to January 24, 1922,—covering 10 years plus. These patients have been followed up to date as far as possible—thus far 11 years and 5 months. We include all treated, whether hopeless, far advanced or fairly early. But one had symptoms under 6 weeks, and she, though benefited, refused a second treatment after 170 millicurie hours given internally. The following table shows the condition of the patients on admission. The total number treated is 230; in 30, sufficient data as to the effect of radium are wanting, and this number has been deducted from the total, leaving 200 in the series to be considered.

TABLE I

Total treated	230
Number not reported	30
Total in the present series	200

	Cases	Per Cent
Apparently hopeless from radium or any other viewpoint	19	9.5
Metastases and involved glands	20	10
Operable	12	6
Inoperable	145	72.5
Previous operations on the disease	43	21.5
Previous colostomies done (hopeless and inoperable groups in part)	16	8
Previous exploratory operations without removal (several of the colostomies)	7	3.5
Recurrent after former operation	33	16.5
Prophylactic treatment after operation	10	5
Previous radium treatments in	10	5
Previous X-ray treatments in	9	4.5

Only 6 per cent were considered as at all operable, the rest were inoperable, and as a rule applied for radium as a last resort.[1] Out of this conglomerate group 11 per cent were cured, 62 per cent benefited to a lesser or greater degree and 27 per cent were left unbenefited. In order to analyze our results and to obviate the confusion of considering such a heterogeneity of cases as we list above, let us divide them into four groups: namely, (1) the utterly hopeless cases (9.5 per cent); (2) those not benefited by treatment; (3) those benefited; (4) those apparently cured.

Hopeless cases. In dealing with an apparently hopeless case, all one can expect is to give some measure of relief; if this is accomplished, the effort is fully justified. This goal has been reached in over one-half of our hopeless cases. Out of the 19 under consideration, 12 were improved (63.1 per cent) and 7 (36.9 per cent) unimproved. By improved we mean that some or all of their symptoms were alleviated and they were often made comfortable up to the exitus. We look back with genuine pleasure upon these concrete services to this wretched despairing class. Our improved hopeless patients lived from 2 months to over 3 years. Of those not benefited, 3, or a little less than 50 per cent, were inadequately treated for various reasons. Let us consider a typical case:

Mr. M. A. P. (5476), age 44, entered the hospital September 20, 1919, with a history of bleeding, pain, and loss of weight for over 3 months. In July, 1919, a colostomy had been done for obstruction. An extensive growth was found and a note made that there were probably deep abdominal metastases. A course of five treatments was given, totaling 56.9 gram hours, externally, distributed over the sacrum and abdomen. Following these treatments there was a decrease in the amount of bleeding, pain was relieved, the discharge lessened, and he lived for a year, dying finally with metastases in the liver.

Cases not benefited by radium. This class numbers 54, or 27 per cent. The following summary will show the condition of such patients when first seen:

TABLE II

Hopeless class	7
Constitutional symptoms marked in	11
Postoperative—no immediate recurrence (prophylactic radiation)	1
Tumor mass fixed	22
Not fixed	3
Degree of fixation not stated	29

This list shows that there were really only 4 cases (three not fixed and one radiated prophylactically) which were disappointing in the outcome. Why these 54 cases failed to respond we cannot say as some of them received as much radiation as others who were greatly relieved or even cured. The unsatisfactory answer must be for the present that they were not equally "radio-sensitive." In consulting Tables IV, V and VI one will find the type of treatment given and the percentage of non-improvement for each type of treatment.

[1] It will be noted that in addition to the inoperable group, there are some who came to us with recurrences and others who came for prophylactic radiation. The operable group does not include those who were operated upon previous to admission.

In 6 cases there has been a definite increase in the growth, which might be attributable to the so-called radium stimulation or to the marked insensitiveness of the tumor to radium. One of these cases received a very heavy dosage, the others were mild but should have shown some improvement.

Cases benefited. In this class we place all those whose symptoms were alleviated or entirely relieved, including the hopeless class and the extensive cases who were helped in any definite degree. The entire number benefited is 124, or 62 per cent of the total. A summary of the improvement in the individual symptoms will be of interest.

TABLE III

	Improved	Not improved	Not reported
General improvement	80	5	30
Mucus discharges	65	8	51
Noted locally	104	7	13
Weight	49	7	68
Cessation of bleeding	68	1	55
Lessened pain	102	5	17
Prevention of colostomy by relief of obstruction	8	..	..
Constipation	25	1	98

In Table III, in the third column, marked "Not reported," are placed those cases in which no definite statement was found in the history concerning that particular symptom, or perhaps the patient did not complain of the given symptom. In some of the cases the local improvement was even to the extent of complete disappearance of the local tumor, while metastasis developed. This shows clearly the need of getting the patient early before metastases. We have seen, however, temporary improvement where metastases have been local or to neighboring glands.

We would call attention to the fact, as shown by Table III, that in 8 cases the obstruction was sufficiently relieved to obviate an impending colostomy. Nine of these 124 improved cases had been found inoperable at previous exploratory operation.

Before considering the "cured cases," it might be well to consider the values of the various types of treatment, as well as the relationship of these types to combination treatment, that is to say, radium plus operation or radium plus colostomy. We have prepared three tables for this purpose. In each table we first cite the well cases, then the improved ones according to the length of improvement, then those not improved. The number of hopeless and extensive cases of each group is mentioned merely for the sake of comparison. The upper half of Table IV is a classification showing the values of each type of treatment with numbers and percentage.

Of the cases which were treated with radium alone, where there were 6.3 per cent hopeless and 61.7 per cent extensive, there is an actual cure of 8.5 per cent. These will be considered more carefully under the "cured cases." The palliation in this group is 65.9 per cent, 37 per cent of which (24.2 per cent of this group) lived over 18 months. The combination radium treatment, that is to say given externally and internally, gave the highest percentage (70.3 per cent) of palliation and apparent cures (11.2 per cent). The cures with the external treatment were about the same (11.1 per cent), but the internal alone were lower (5.8 per cent). External and internal gave about the same amount of palliation. There are hardly enough cases treated with needles alone or needles plus internal application to justify drawing conclusions as to those methods. It is interesting to note that even though there are no well cases in the group treated by a combination of all three methods, there is only one case not improved. The number here is also too small for conclusions, but of the 9 so treated, all but one were helped. One has remained well a year and a half after one implantation of 14 needle points of 1.5 millicuries each.

Of the four cases in this group pronounced operable on admission, two are well and two were benefited. (Two of these four cases refused operation, one preferred radium and there are no notes why the other was given radium instead of operation.) In other words, of the operable cases treated with radium *alone*, 50 per cent are well and 50 per cent benefited.

In considering the radium plus operation group, we find a higher percentage of well patients (17.5 per cent) than in those treated with radium alone; we find, too, that the re-

TABLE IV.—GROUP I—PATIENTS TREATED WITH RADIUM ALONE

Arrangement according to method of treatment	External		Internal		Needles		All three		Ext. and needles		Ext. and internal		Int. and needles	
	Pts.	Per cent	Pts.	Per cent	Pts.	Per cent	Pts.	Per cent	Pts.	Per cent	Pts.	Per cent	Pts.	Per cent
Improved	16	59.2	10	58.9	1		8		3		10	76.3	5	....
Not improved	8	29.7	6	35.3	1		1		3		5	18.5	0	....
Well	3	11.1	1	5.8	1		0		0		3	11.2	0	....
Total patients	27		17		3		9		6		27		5	....

SUMMARY

Duration	No. of patients	Percentage of patients in this group
Well	8	8.5
Improved 6 months	19	
1 year	20	
18 months	12	
2 years	5	
Over 2 years	6	
Total improved	62	65.9
Not improved	24	25.6

Duration	No. of patients	Percentage of patients in this group
Total patients in this group	94	
Apparently hopeless from radium or any other viewpoint	6	6.3
Extensive	58	61.7
Operable	4	4.2
Inoperable	90	95.8

TABLE V.—GROUP II—PATIENTS TREATED BY RADIUM PLUS OPERATION

Arrangement according to method of treatment	External		Internal		Needles		All three		Ext. and needles		Ext. and internal		Int. and needles	
	Pts.	Per cent	Pts.	Per cent	Pts.	Per cent	Pts.	Per cent	Pts.	Per cent	Pts.	Per cent	Pts.	Per cent
Improved	11	42.4	2		1		2		4		8	47.1	1	....
Not improved	6	23	2		0		0		2		8	47.1	0	....
Well	9	34.6	0		0		1		0		1	5.8	0	....
Total patients	26		4		1		3		6		17		1	....

SUMMARY

Duration	No. of patients	Percentage of patients in this group
Well	11	17.5
Improved 6 months	7	
1 year	5	
18 months	4	
2 years	5	
Over 2 years	8	
Total improved	30	50.5
Not improved	18	32

Duration	No. of patients	Percentage of patients in this group
Total patients in this group	58	
Apparently hopeless from radium or any other viewpoint	5	8.4
Extensive	16	27.5
Recurrent after operation elsewhere	33	57.9

sults of the various methods of treatment were similar. An improvement was noted in 50.5 per cent of the cases and about 60 per cent of these lived 18 months or longer. These were naturally much earlier cases, and some had been operated upon before coming to us, but when admitted 8.6 per cent were recurrent and hopeless and 27.5 per cent were recurrent and extensive. The two classes which afford sufficient data for comparison are those treated (1) externally and (2) externally and internally combined. In the first there was a 42.4 per cent palliation and a 34.6 per cent cure. Two of these cured cases came with a recurrence, 5 for prophylactic treatment, and the remaining 4 had operation after admission. The second class (2) yielded but one well patient but a palliation of 47.1 per cent; here,

TABLE VI.—GROUP III—PATIENTS TREATED BY RADIUM—COLOSTOMY

Arrangement according to method of treatment	External		Internal		Needles		All three		Ext. and needles		Ext. and internal		Int. and needles	
	Pts.	Per cent	Pts.	Per cent	Pts.	Per cent	Pts.	Per cent	Pts.	Per cent	Pts.	Per cent	Pts.	Per cent
Improved	7	46.7	4		1		4		1		14	82.6	2	
Not improved	7	46.7	1		0		1		1		2	11.6	0	
Well	1	6.6	1		0		0		0		1	5.8	0	
Total patients	15		6		1		5		2		17		2	

SUMMARY

Duration	No. of patients	Percentage of patients in this group
Well	3	6.3
Improved 6 months	9	
1 year	9	
18 months	9	
2 years	3	
Over 2 years	3	
Total improved	33	68.7
Not improved	12	25

Duration	No. of patients	Percentage of patients in this group
Total patients in this group	48	
Apparently hopeless from radium or any other viewpoint	7	14.8
Extensive	19	40.4

	Well	Improved	Not improve
Colostomy prior to radiation	2	16	6
Colostomy following radiation (for obstruction)	1	17	6

however, was a larger number of unbenefited patients (47.1 per cent). It is interesting to note the high percentage of palliation in the other classes of this group, in some of which the tumor was radiated down to an operable size and then removed.

Thirty-three patients in this group were sent to us after recurrence from former operation. Of these, 2 (9.1 per cent) are well; 19 (57.5 per cent) were benefited by the radium treatment and 12 (33.4 per cent) were not benefited by radiation. By careful study we found that these results have no relationship to the time of the recurrence, the type of operation or the fixation of the recurrent tumor.

The radium-colostomy group did not give such good results as to well patients; it did give the highest percentage of palliation (68.7 per cent), with the lowest percentage of non-improvement (25 per cent). Of the 68.7 per cent palliation, 45.5 per cent lived 18 months or longer. Here, too, there were hopeless (14.8 per cent) and extensive (40.4 per cent) cases. In spite of this, however, 6.3 per cent are well. It made little difference whether colostomy was done prior to radiation or after obstruction seemed evident. External radiation alone yielded equal palliation and non-improvement in its class with a 6.6 per cent cure. Combination of internal and external treatment, however, brought an 82.6 per cent palliation, although only 5.8 per cent (one case) was well. In this case colostomy was done 10 days after admission because the growth did not diminish. All treatments were given prior to colostomy, the last one being on the day of the colostomy. Another case was operable on admission but had had a colostomy performed before admission. That patient is well.

Let us consider here another interesting group—those who came with an operable tumor. There are 12 in all, and we find that 6 are well (50 per cent), 5 were benefited (41.6 per cent) and one left unbenefited (8.4 per cent).

Five of these cases were treated with radium alone. (The choice of radium therapy over operation was made because two refused operation, one chose radium in preference to operation, and in one radium was given because operation would destroy the sphincter. In the fifth case no note was found on the history why radium was chosen.) Of these 5, 2 are well—one 7½ years (this one was a basal cell carcinoma) and one 10 years, two were

TABLE VII.—OPERABLE ON ADMISSION

	Radium	Radium and operation	Radium and colostomy
Well	2—50%	3—50%	1—50%
Improved	2—50%	3—50%	0
Unimproved	0	0	1—50%

improved and only one not improved. The last mentioned did not yield to treatment, necessitating a colostomy 6 months later.

In 6 cases the combination of operation plus radium was used. The operative procedure consisted of either perineal resection or the Kraske method of extirpation, depending on the site of the lesion. Three of the six are well—5, 7½, and 8½ years respectively. Two of the well ones were radiated after and one before operation. Two of the improved cases were operated upon following radium treatments and diminution in the size of the tumor. (One of these was too old to stand the shock of the operation, the other lived 3 years.) The third case was operated upon twice and radiated after each operation—improved and lived 2 years.

The eleventh case of the operable group had a colostomy done before coming to the hospital, having been diagnosed inoperable carcinoma at previous exploratory laparotomy—but by us operable. He has remained well for 9½ years after radium treatments. The twelfth case had radium followed by a colostomy but was not benefited.

Table VII visualizes this group of cases which were operable on admission.

It is interesting also to observe the length of time the patients in all these various groups have been benefited (Table VIII). The following table is based on the duration of life after the date of admission, as the majority of cases were treated up to or within a few months of death:

Cured cases. In any method of treatment the great question is "how many cures?" In the 200 cases under discussion we find that there are 22 (11 per cent) apparently cured ranging from 1 to 10 years.[1] Fourteen of the

[1]In addition to these 22 cured cases, there is one which had an exploratory operation before admission and was pronounced inoperable carcinoma. The tissue taken at our examination was diagnosed "probable benign papilloma." When last heard from, 1 year after treatment, patient was well.

TABLE VIII

Lived less than 6 months but benefited	25
Lived 6 months and benefited	14
Lived from 6 months to 1 year and benefited	43
Lived from 1 year to 18 months and benefited	20
Lived from 18 months to 2 years and benefited	14
Lived from 2 years to 3 years and benefited	10
Lived from 3 years to 4 years and benefited	5
Lived from 4 years to 5 years and benefited	1
Lived from 5 years to 6 years and benefited	1
Total	133

22 (7 per cent of the total number) remained well for five years or longer. These "cured cases" may be divided into three classes: (1) those cured by radium alone, (2) those cured by radium plus operation, (3) those cured by radium plus colostomy.

In the first class belong 8 cases or 4 per cent of all cases treated. Of the 200 treated, 94 had radium alone; and of these, 8 are well. In other words, radium in itself claims a cure of 8 cases out of 94 treated or 8.4 per cent of all cases where radium was used exclusively. In dealing with the second group let us premise before stating statistics: this group contains those who have had radium plus operation with in some cases a colostomy, especially where a colostomy was done in preparation for the operation. The emphasis here, however, is to be placed on the operation-radium therapy in contradistinction to the radium-colostomy group. There are 58 cases in this group with a cure of 11 cases or 17.5 per cent, or 5.5 per cent of the total number of cases in the series of 200. Seven of the 11 cured cases were sent to the hospital after operation. Two cases were recurrent after the operation and have remained well 7 and 9 years respectively. The remaining five were given prophylactic radiation only and have remained well: one, 2, two, 7½, one, 5, and one, 8 years. One of the recurrences was so bad that an immediate colostomy was required on admission in addition to radiation, but the patient has remained well 9 years. Of the 4 operated upon after admission there are 2 which were operated upon after radiation—one in which a Kraske was done 3 months after the last radium treatment and one in which a vaginal resection was done 1½ months after radiation. The first is well 7½ years, the second is well 4½ years. One case was operated

upon after admission but *before* radiation and remained well one year but died from shock after two other operations for prolapsus. The fourth is still living 8½ years after the first treatment, some treatments having been given before and some after operation.

In the third class, those cured by radium and colostomy, there are 3 cases or 1.5 per cent of all treated. In the entire series there were 48 patients who had a colostomy in addition to radium; that is, 6.3 per cent of the colostomy-radium group are cured, or 3 out of 48 cases.

To summarize briefly the cured cases, we may say that operation-radium therapy cured 17.2 per cent of its series, radium alone cured 8.4 per cent and colostomy-radium cured 6.4 per cent. In analyzing the 22 cured cases we find that the periods of cure have been as follows:

TABLE IX

	Cases		Cases
Well 10 years	1	Well 4½ years	1
Well 9½ years	1	Well 4 years	1
Well 9 years	2	Well 3 years	1
Well 8 years	3	Well 2½ years	1
Well 7½ years	3	Well 2 years	2
Well 7 years	1	Well 1½ years	2
Well 5 years	2	Well 1 year	1

CONCLUSIONS

1. Radium used alone or with some operative procedure is par excellence our most valuable therapeutic agent in the treatment of cancer of the rectum in all stages. Its therapeutic value lies both in its palliation and its high percentage of cures—11 per cent of those treated. As a palliative measure it benefited 62 per cent of all the cases. In the hopeless group radium is valuable in giving relief to various symptoms and affording comfort for the remainder of life. There are a number (27 per cent of the total) who did not respond and these we term for the present as not "radio-sensitive." In this group the tumor was fixed in 40 per cent, and practically all were well advanced. The one way to determine the radio-sensitiveness of a tumor is a substantial treatment followed by careful observation; in other words, the great benefits to be expected from radium justify its trial in every case of cancer of the rectum.

2. As to the best method of radium application, sufficient data are not at hand at present to draw positive conclusions. We feel that we must give the implantation of needle points a fuller trial as we believe that it alone, or it combined with other methods, will yield the highest percentage of improvement and of cures. At present we can say that uniformly, whether by radium alone or in combination with operation and colostomy, a combination of external and internal application gives the highest percentage of palliation, while the radical operation plus external treatment yields the highest percentage of well patients, namely 32 per cent, and external treatment in cases where there was no operation gave a cure of 11.1 per cent.

Briefly, the procedure in treating a case of carcinoma of the rectum as indicated by our results would be: (1) If the case is operable, radiate and operate, there being little choice which should be done first, but especially radiate externally. If all the growth cannot be removed, either treat internally as well as externally or implant bare glass needle points if sufficient growth remains after the operation. This can be done at the operation. (2) If the patient is inoperable or a border-line case, treat heavily with external and internal radiation and implant in the hope of bringing the tumor to an operable size or causing it to disappear entirely. If it becomes operable, operate and radiate again, if necessary. If there is postoperative recurrence, radium offers excellent palliation and a good chance of cure. Of all the well cases, 9.9 per cent were recurrent after previous operations. (3) If on admission there is obstruction, a colostomy should be done; however, from our statistics it does not seem wise to do a colostomy as a routine or even as an expedient measure unless there is obstruction.

Finally, in this series radium therapy has been helpful in obtaining 11 per cent cure and a 62.5 per cent palliation of all cases in the series of 200 suffering from carcinoma of the rectum treated in our hospital.

TUBERCULOUS TENOSYNOVITIS OF THE HAND

A Report of Fourteen Cases of Tuberculous Tenosynovitis[1]

By ALLEN B. KANAVEL, M.D., Chicago

THE accompanying report of fourteen patients with tuberculosis of the tendon sheaths of the hand, who have been under my care during the past few years, serves to emphasize the necessity for early recognition of this condition and the possibility of complete cure by adequate and properly directed treatment. The necessity for early recognition is emphasized by the fact that fragmentation of one or more tendons was present in six out of fourteen patients; secondary involvement of the wrist in two; and osteomyelitis of the index finger in one. These complications in my judgment were secondary to the tendon sheath involvement. The possibility of complete cure is attested by the results presented in several patients observed over a number of years.

ETIOLOGY

The ages of these fourteen patients varied from 19 to 60; one was 51, another 42, and eleven were in the third decade of life. The four with tuberculosis of the dorsal sheaths were 21, 26, 27, and 28 years respectively. While no age is exempt, the disease shows a predilection for the early years of adult life.

The influence of trauma as an etiological factor cannot be denied, although specific instances may be lacking. One of my patients was a shoemaker, another an artisan who constantly handled tools, and another a mail clerk. That trauma is a dominant factor is improbable, since in four patients the lesion involved only the dorsal tendons; but it is doubtless more than a coincidence that in all but one case the right hand was involved, and the single case of involvement of the left hand occurred in a left-handed individual. Similar observations concerning the hand involved have been made by other writers.

The possibility of infection entering through the skin of the hand itself is suggested by the sequence of events in the case of a patient who noticed first a small nodule on the thumb, which he himself picked off. Removal of this nodule was followed by a discharge of pus. After the infected area was incised, it remained healed for a time; but in a month the discharge reappeared and continued intermittently for about a year, when the patient noticed that the wrist was swollen. Not until then did he come for operation. In this particular case it cannot be denied that the tuberculous process may have been present in the tendon sheath previous to the appearance of the nodule on the thumb.

In only one of my patients was there a demonstrable lesion in the lungs, and none had evidences of tuberculosis elsewhere. I am informed, however, that in sanitaria for tuberculosis, tuberculous disease of the tendon sheaths is not at all uncommon as a complication or sequela of pulmonary tuberculosis. That it is frequently present without an evident lung involvement is certain.

PATHOLOGY

Our knowledge of the disease dates from the observation of a case recorded in 1756 by Olaf Acrel, of Stockholm. This report was followed by others from Dupuytren, Velpeau, Laennec, Cloquet, and later by observations from German writers,—Heineke, Virchow, Brodie, and others. One of the earliest comprehensive studies was made by Michon, who apparently recognized the tuberculous nature of the disease; but it remained for Hoeftmann to demonstrate the presence of giant cells and tubercles.

The disease may appear in various forms. In the simplest type, a serous exudate alone is present. Later, granulation tissue and rice bodies appear, and, finally, in the severest forms, fungus formation and extensive necrosis take place. These variations are doubtless due to the duration of the disease, the varying resistance of the individual, and the varying

[1]Read before the American Surgical Association, Rochester, Minnesota, May 31, June 1 and 2, 1923.

a *b* *c*

Fig. 1. Tuberculous tenosynovitis of ulnar and radial bursæ (*a*, *b*) with perfect functional result after operation (*c*).

Fig. 2. Hygromatous form of tuberculous tenosynovitis with melon seeds (from patient in Fig. 1).

toxicity of the organism. In my own patients all of these variations in pathology have been observed.

The affected area, whether it involves the dorsal or volar surface of the forearm, the wrist, the palmar surface of the hand or the individual fingers, appears as a more or less spindle-shaped swelling (Figs. 1, 3, 5, 6, 8, 9). This swelling may give a definite sense of fluctuation; it may be doughy; it is rarely hard and firm. Early in the course of the disease it may be so ill defined as to leave a question as to its actual presence.

On incising the skin over the affected area, the deep fascia appears more tense than normal, and the fascia and superficial tissues may appear slightly œdematous. On incising the deep fascia, evidence of pathological change immediately appears. The tendon sheaths are no longer white, and glistening, but yellowish-white, grayish-red, gray, purple, or bluish-purple. Instead of herniating quickly through the smallest opening in the deep fascia, the œdematous tissue tends to herniate into the wound only when an incision of some length is made. On incising it, this œdematous tissue is found to consist of the thickened tendon sheaths and tendons, more or less closely matted together (Fig. 10). If the process is not far advanced it is possible to separate the individual tendons from one another. Then it may be seen that the involved tendons, with their sheaths, form a fusiform enlargement. The vascular sheath varies in thickness from 0.5 to 3 millimeters, depending on the duration of the disease. On incising the sheath the thickened tendon appears within it (Fig. 11, B). Much of the fusiform enlargement disappears as thin, straw-colored fluid pours from the open sheath. The thickened tendon is still free in the sheath, and on incising the tendon, it is found that the thickening is due to involvement of the visceral layer of its sheath. The white fibrous tendon is still intact within the soft, vascular granulation tissue which has replaced the normal, tissue paper, visceral layer of the tendon sheath. During this stage the tendon can still be dissected out of the tuberculous sheath and shows little or no pathological change. This is the earliest stage of the so-called hygromatous form.

In a later stage the sheath becomes partially obliterated by fibrous tissue formation. Fluid is confined to a definite portion of the sheath, and rice bodies may appear in the fluid.

Still later the fluid is replaced by a caseous substance which may be localized in one or two areas. The tendon sheath is replaced by granulation tissue, and later by fibrous tissue; fragmentation of the tendons takes place (Fig. 12), and several tendons, or all of them,

Fig. 3. Tuberculous tenosynovitis of ulnar and radial bursæ with plastic repair of the tendons. *a*, before; *b*, immediately after; *c*, 2 years after operation.

may be firmly bound together in a mass of fibrous tissue.

The description of the findings at operation in two of our cases is very characteristic. In the first case (C., Wesley Memorial Hospital No. 86002), the report is as follows: "The tendons looked bluish, distended, and much thickened. On opening the tendon sheaths, the apparent enlargement was seen to be due to a homogeneous mass of granulation tissue, which in places seemed to be breaking down and to look caseous. This tissue surrounded the individual tendons like a sheath." In another case (S., Wesley Memorial Hospital No. 103348), the report states: "The tendons of the four fingers were involved from a point 2 inches above the volar carpal ligament to the webs of the fingers. In the distal half of the palm, a little to the ulnar side of the midline, was a definitely encapsulated mass, the size of a small egg, filled with sago-like substance, but without fluid and without melon seeds (Fig. 5). To the wall of this mass the tendons of the third and fourth fingers were firmly adherent. All traces of the tendon sheaths of the four fingers had disappeared, and the isolation of the individual tendons from the fibrous tissue which bound them together was extremely difficult."

These varying conditions, described as characteristic of different stages of the disease, may at times be seen in the same individual. Straw-colored fluid with rice bodies may be present in the radial and ulnar bursæ while the tendons of the fifth finger in the palm have undergone almost complete fragmentation and division. Such fragmentation can occur while the tendon still moves freely in its sheath.

The final stage of the uncomplicated disease, the fungus form, is characterized by extensive formation of granulation tissue and caseation, with or without rice bodies. The exposed tuberculous mass is very vascular, soft, and of a grayish-red or purple color. It looks like a sausage-shaped enlargement which has replaced the tendinous mass. When the soft, thick granulation tissue forming its outer wall is incised, the interior of the tendon sheath with the involved tendon is exposed. There may be some thick, gelatinous, straw-colored fluid present; there may be rice bodies (Fig. 2); there may be only caseous material within the synovial space (Fig. 5). At times the swelling may be bilocular, with rice bodies present in one loculus and gelatinous fluid in another. The lining membrane of the tendon sheath is no longer glossy and shining, but dull and lusterless. It may be adherent to the tendon in a part of its course; it frequently shows areas of caseation and necrosis.

The visceral layer of the sheath is involved like the parietal layer. The extent of involvement of the tendon contained within it depends on the duration of the disease. Fragmentation and division of the tendons are the ultimate result. Union of several or all the tendons in a thick mass of scar tissue represents nature's attempt at cure. It was this

Fig. 4. Tuberculous tenosynovitis of ulnar and radial bursæ. *a*, before; *b*, *c*, after operation.

particular type of tuberculous disease which lead both Lisfranc and Chassaignac to make a diagnosis of sarcoma in lesions which Michon later showed to be tuberculous.

Eventually, if healing by fibrous tissue formation fails to limit the pathological process, extensive caseation takes place, the involved tissues break down, sinuses are formed, and finally a secondary infection is superimposed on the tuberculous process.

Any of the individual tendon sheaths may be involved, but multiple involvement seems to be more common on the dorsum than in the palm. The palmar involvement follows strictly upon anatomical lines, so that we may have isolated involvement of the tendon sheaths of the index, middle, and ring fingers; but if the process involves the little finger or thumb primarily, both ulnar and radial bursæ are involved in nearly every case. An ulnar bursal infection is practically always followed by extension to the radial bursa, and the converse is also true, and in both instances the extension of the bursæ above the wrist shows involvement. When the melon seeds rupture into the forearm, they are always found lying upon the pronator quadratus and the interosseous septum, under cover of the flexor profundus digitorum. In one of my patients there was involvement of the ulnar and radial bursæ with simultaneous involvement of the tendon sheath of the ring finger, and in another patient a tuberculosis of the tendon sheath of the index finger (Fig. 6) developed 6 years after operation for a tuberculous process involving the ulnar and radial bursæ. During the intervening 6 years there was no clinical evidence of a tuberculous process in the index finger.

Upon the dorsum multiple sheath involvement is more common (Figs. 8, 9).

It is an interesting observation that while there was often fragmentation of tendons—in six out of fourteen patients—in only one case were the tendons of more than one finger destroyed. In one case the tendons of the index finger were involved, in two those of the little finger; in a fourth case the flexor longus pollicis was involved, and in the fifth case the extensor longus pollicis. In our last case, a definitely encapsulated mass had formed in the palm (Fig. 5), to the wall of which the fragmented tendons of the third, fourth, and fifth fingers were adherent. In ulnar bursal infection, destruction of the tendons of the little finger is most common.

Attention should be drawn particularly to the involvement of the median nerve in tuberculosis of the ulnar and radial bursæ. The anatomical relations of the nerve in the forearm, at the wrist and distal to it, are such that it must inevitably be involved in the process (Fig. 10). While in my cases it has always been surrounded by the tuberculous mass, in no case has there been destruction of the nerve, although it is frequently swollen and hyperæmic.

Tuberculous tenosynovitis does not tend to become generalized or to involve the regional lymph glands, although one of my patients presented a tuberculous focus on the skin of the forearm of the elbow. Either the hygromatous or the fungoid form may extend to the surface, or to joints, and produce typical skin and joint lesions with fistulæ. Cold abscesses seldom, if ever, appear, but following the formation of fistulæ acute inflammatory processes may develop, with all the serious consequences that follow suppurative tenosynovitis. Rupture of the hygromatous sheath into the forearm with the extension of rice bodies under the flexor profundus often occurs, while less often there may be a rupture into the middle palmar space, as was shown in one of my patients (Y., Wesley Memorial Hospital No. 37802).

The histological picture is that of tuberculous tissue elsewhere, with much endothelial proliferation, with an irregular connective-tissue ground substance, interspersed with giant cells in its deeper layers, with tubercles and with coagulation necrosis. The involved tendons as well show giant cells in many places (Fig. 7).

During the earlier years great controversy raged over the origin of the rice bodies and melon seeds, which had been compared by Acrel to cooked sago. Dupuytren was the first to call attention to the central cavity that is often found in these bodies. He believed them to be hydatid cysts and to contain parasites. Laennec, Hipp, Cloquet, and the parasitologist, Chiajie, concurred in this theory, so that the disease became known as Dupuytren's hydatid tumor. The majority of observers believed the rice bodies to be unorganized concretions arising from the coagulations of the fibrin in the synovial fluid of the tendon sheaths. Velpeau called attention to the presence of similar bodies in joints and mucous bursæ, and believed they were developed from fibrin, lymph, and some from pus. Hyrtl in 1842 described a case in which rice bodies seemed to be necrotic portions of the tendon sheath wall. After Michon (1851) called attention to the organized nature of these bodies, Virchow suggested that they originated from the coagulation of an albuminous substance, and was seconded in this theory by Heineke, Brodie, Beger, and Koenig. Better staining methods and further study demonstrated that they have their origin in the degeneration products of the tuberculous granulation tissue and contain, in addition, accretions from the fibrin deposit. The exact origin of the rice bodies is an academic question, but the fact that their presence is pathognomonic of tuberculosis is of importance, although isolated cases are reported in which tuberculosis has not been demonstrated.

The histological picture of a rice body presents chiefly fibrinous material, which contains here and there a giant cell with the bacillus tuberculosis. Goldmann and Garre showed that these bacilli are capable of producing tuberculosis in a guinea pig, if the rice bodies are implanted in the peritoneal cavity, although not all the bodies contain bacilli.

Fig. 5. Fungoid form of tuberculous tenosynovitis.

SYMPTOMATOLOGY

In general the symptoms and signs are those of a slowly developing enlargement of the involved area, with impairment of function of the tendons and of the median nerve. At first the patient complains only of a stiffness of the hand, an inability "to make a fist." There may be no history of spontaneous pain. At certain stages of the disease a leathery crepitation may be felt and heard on movement of the tendons, but this soon disappears and is generally not elicited when the patient presents himself for treatment.

The swelling follows the anatomical outline of the sheath involved. In the case of the ulnar and radial bursæ, there is a fullness at the base of the palm, more marked upon the the ulnar side. Above the annular ligament the lower part of the volar surface of the forearm is enlarged (Figs. 1, 3, 5). If the two hands are held up side by side and observed from the lateral aspect, the relatively greater thickness of the affected arm is clearly seen (Fig. 8). Pressure above the wrist will cause the palmar swelling to become more tense.

Owing to the involvement of the median nerve, the patient not infrequently complains of numbness and tingling, particularly on the sides of the index, middle, and ring fingers, and often impairment of sensation can be demonstrated. One might expect that the

Fig. 6. Tuberculous tenosynovitis of index finger secondary to tuberculous tenosynovitis of ulnar and radial bursæ successfully operated upon 6 years previously.

congestion of the nerve would give rise to much pain, particularly in the early stages, but this complaint has not always been present. In one case, however, the character of the pain and its course were so typical of what one would expect that the history with reference to this symptom is taken from the interne's record (R., Wesley Memorial Hospital No. 92841). "About three years ago, as far as the patient can remember he lifted something and noticed some slight pain in this wrist joint. About 12 hours later the pain became very severe, and a swelling appeared over the flexor surface of the wrist joint, and, to a slighter degree, over the thumb. During the succeeding weeks the swelling fluctuated in size, but a dull pain was constantly present and was aggravated by motion. The pain was seemingly worse at night, and for 6 months the patient would get up two or three times at night, unable to sleep on account of the excruciating pain. About 3 weeks after the onset he noticed a numb feeling over the middle and ring fingers and a stiffness in his joints. For the past 2 years there has been comparatively no pain."

In our last case the history dates back 7 years. The patient first noticed a swelling about the ulnar side of the wrist, and pain which extended up the forearm and down the

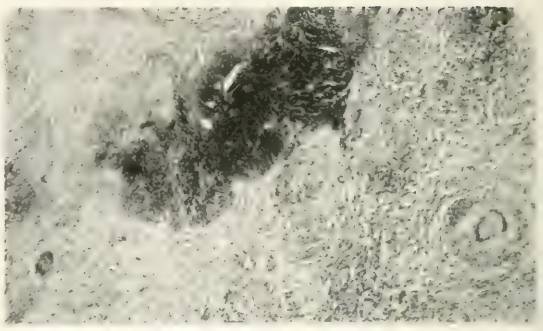

Fig. 7. Cross section of tendon removed from patient in Figure 6, showing characteristic tubercle formation.

fingers. This pain was described as a "terrible burning," so that the patient frequently got up at night to plunge her hand and forearm into ice-cold water. She sought one doctor after another and applied lotions, ointments, and packs without affecting the pain in any appreciable degree. A year after the onset, the severity of the pain diminished very markedly, and for the past 6 years there has been little spontaneous pain. Another patient whose history extended over a period of 18 months stated that for the first 6 months she had severe burning pain throughout the hand and forearm, particularly at night, and when the hand was elevated. She hung the arm over the side of the bed to relieve the pain, and frequently got up at night to plunge it into a reservoir of hot water which stood at the back of the kitchen stove.

When rupture of the melon seeds from the ulnar bursa into the palm has taken place, the middle palmar space is involved and the concavity of the palm is lost. When the rupture has occurred into the forearm, a general swelling of the entire flexor part of the lower half of the forearm is noted. Even before fragmentation of the tendons occurs, there is partial loss of function of the fingers involved. Stiffness, swelling, the inability to flex or extend the finger completely, are the earlier symptoms. Loss of power and finally inability to move the fingers indicate extensive involvement of the tendons.

When the tendon sheaths on the dorsum are involved, the patient complains of little except stiffness, and a fluctuating swelling over the anatomical outline of the sheaths. There is

a *b*

Fig. 8. Tuberculous tenosynovitis of the dorsal tendon sheaths of the left hand and wrist, *a;* the right hand and wrist, *b*, are normal.

Fig. 9. Tuberculous tenosynovitis of the dorsal tendon sheaths.

little limitation of motion and little or no pain and tenderness. Crepitation may be felt at certain stages of the disease.

In old neglected cases and those with bone and joint involvement, fistulæ form, secondary infection ensues, and the typical well-known picture of joint and bone tuberculosis is presented.

Systemic symptoms are so slight as to be of no importance, but other foci of tuberculosis should always be sought.

TREATMENT

Tuberculosis of the tendon sheaths, if unaccompanied by active lesions elsewhere, is probably one of the least difficult of tuberculous processes in which to obtain complete cure. This may be secured either by conservative treatment such as removal of the melon seeds, injection of iodoform emulsion, and immobilization by splinting for a considerable period, or by complete surgical removal. The former method requires considerable time for its application, with consequent loss of use of the hand. As a result of prolonged immobilization, atrophy and contractures of the muscles take place, fibrous adhesions form about the joints, and these conditions are accentuated by the temporary loss of nerve function and by the involvement of the nerves in the pathological process itself. These results, however, are usually transitory, and function is restored some weeks or months after removal of the splints. It may be advisable to combine active surgical intervention and immobilization in advanced cases, if the bones and joints are involved in the process.

In my earlier cases, the first method was utilized, but in later years the results obtained by complete dissection have been so excellent, both as regards eradication of the disease and the prompt restoration of function, that this method has been used exclusively. I have several patients treated some years ago by the conservative method in whom good results were obtained, but the records are inadequate and I have not been able to get them to return for a verification of the result, so that, with one exception, these are not included in the present report. The exception is that of a patient (Y., Wesley Memorial Hospital No. 37802), who was first observed in 1912. He was suffering from tuberculosis of the ulnar and radial bursæ with extension into the palmar space and the forearm, with several tuberculous sinuses, and with probable involvement of the wrist joint. Short incisions were made in the palm and in the forearm, the melon seeds present were

evacuated, and an injection of 10 per cent iodoform emulsion made. Splints were applied for a number of months. Meanwhile iodoform emulsion was injected into the sinuses from time to time and tuberculin was administered. After about a year the process seemed to have been entirely eradicated and he began to use his hand. Three years later he came under the care of another surgeon, with a recurrence at the wrist. Splints were reapplied for 6 months, and since the expiration of that time he has been entirely well except for some limitation of motion at the wrist joint. He was examined in May, 1922, and showed no evidence of active tuberculosis either in the wrist or elsewhere. The severity of the condition when this patient first came under our care and the long period during which he has been under observation show conclusively the possibility of cure by conservative methods. This fact is confirmed by others and by my own experience in other cases that I have not been able to follow so closely.

I have not included in this critical survey two patients with tuberculosis of the dorsal tendon sheaths in which the process was in the incipient stage, and in which immobilization was resorted to without other procedures —a method which would seem entirely justifiable in early cases or in those patients suffering from active tuberculosis of the lungs.

Thirteen of the patients used for study in this contribution were treated by active surgical intervention. For study these should be divided into tuberculosis of the sheaths of the flexor surface and tuberculosis of the dorsal tendons. This division is necessary, since the technique of treatment is different and, in my hands, unfortunately, the results have not been similar.

SURGICAL TREATMENT

The operation is always done under local anæsthesia—one-half per cent novocaine is injected above the clavicle so as to block the brachial plexus. If nerve blocking is not entirely satisfactory, it is supplemented by infiltration of the ulnar nerve at the elbow and at the site of incision, and by infiltration of the median nerve after its exposure in the wound. After the hand is surgically prepared a rubber glove is drawn over it and the glove incised at the site of operation. A bloodless field is secured by maintaining constriction with a blood-pressure apparatus at twenty points above the systolic blood pressure. The constriction is released at the end of an hour and restored later if necessary; but, if the dissection is done carefully, it is usually possible to complete the operation without renewing the constriction.

By regulating the degree of constriction with the blood-pressure apparatus, and maintaining as low a pressure as is consistent with hæmostasis, the danger of producing a musculospiral paralysis from excessive tension is avoided.

Nine patients with tuberculosis of the flexor tendon sheaths have been subjected to a complete resection of the tuberculous tissue with restoration of function in every case. In the early case the dissection was supplemented by splint immobilization for varying lengths of time. This period has been gradually shortened until now immobilization is not considered necessary except in those patients who may be suffering from a complication of the disease, such as bone or joint involvement. We realize that the number of patients observed is too small to warrant dogmatic statements, but that permanent and satisfactory results may be obtained without immobilization is shown by the successful results in the patients who have been under our care. The avoidance of the disability due to immobilization is a strong argument in favor of early mobilization.

Since, in every case, in which the ulnar bursa has been involved, there has been involvement of the radial bursa also, the operation should be designed so as to reach both bursæ. The technique used in such cases is as follows:

An incision is made upon the flexor surface of the forearm and hand, from 3 inches above the wrist down to the distal flexion crease of the palm (Fig. 10). The incision is made over the middle of the forearm, and extends into the palm at the radial side of the hypothenar eminence. If the tendon sheath of the little finger is involved farther distalward, the in-

cision may be continued to the radial side of the fifth finger as far as necessary, but this extension of the incision is avoided if possible. If the sheath of the flexor longus pollicis, which is directly continuous with the radial bursa, is involved, a second incision is made to ensure an adequate exposure. This incision begins a thumb's breadth below the anterior annular ligament, curves radialward around the thenar eminence and extends distalward on the thumb as far as is necessary. Such an incision will avoid injury of the motor branch to the muscles of the thenar eminence, a branch given off by the median nerve just below the annular ligament.

The incision on the flexor surface of the forearm and palm is continued through the anterior annular ligament and the palmar fascia. The ligament is not sutured after the operation, and I have never seen disability result from its incision.

The first structure sought in the forearm is the median nerve (Fig. 10). This is followed into the palm, the greatest care being exercised to preserve every filament. To aid in the dissection it is my custom to use a pair of spectacles which magnify the tissue about one and one-half times. This has the disadvantage of bringing the operator's face closer to the field, but the advantage of enabling him to recognize and preserve the nerve filaments and small blood vessels. The median nerve is often found completely surrounded by tuberculous tissue, but I have never seen it invaded, although it may be inflamed and swollen to twice its normal size.

When the median nerve has been isolated from the tuberculous tissue and protected by gauze saturated in salt solution, the dissection of the tendons and the removal of the tuberculous tissue is carried out. Each tendon is raised in turn and with a fine, sharp knife the thickened visceral sheath is dissected away (Fig. 11). One is surprised at how little injury most of the tendons have sustained. Usually the tuberculous sheath may be removed and an apparently intact tendon is left behind. As each tendon is freed one holds it aside and passes to the next, the tuberculous tissue meanwhile remaining in one mass or at the most in two.

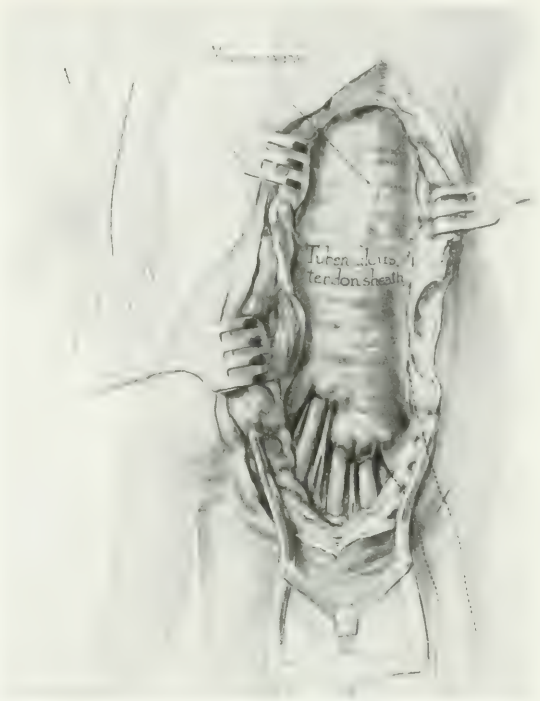

Fig. 10. Operative incision and appearance of tuberculous tendon sheaths.

After the forearm and wrist are thoroughly dissected, one passes into the palm and completes the dissection, using redoubled care not to cut any of the nerve filaments and to avoid injury to the blood vessels as much as possible. The prolongation of the ulnar bursa along the tendons to the little finger requires especial attention. If the sheath going to the little finger or thumb is involved (and involvement of either one is common), both layers of the tendon sheaths are completely removed through the incisions described. It is important not to leave the slightest vestige of tuberculous tissue.

Not infrequently one or more tendons may be found fragmented, but the remaining tendons will be found intact. If the destruction has been slight, I have left the affected tendons in some instances, but have generally felt it advisable to excise the diseased tendon. If the destruction has been in the palmar area, and in ulnar and radial bursal tuberculosis that is its customary location, one can secure excellent functional results by attaching the

Fig. 11. Method of dissection of the tuberculous tissue.

severed ends to the corresponding adjacent tendon, care being exercised to attach them at the proper site to secure the same degree of flexion in both fingers (Fig. 12, A). Since the operation is performed under local anæsthesia, and since the infiltration of the nerve has begun to lose its effect by this time, it is possible to determine the proper site for attachment by inserting a temporary suture and asking the patient to flex his fingers. Prolonged pressure from the Martin bandage or the blood-pressure apparatus will paralyze the nerve temporarily so that contraction of the muscles may be impossible, but a proper appreciation of the relative position of the two fingers and of their tendons will enable one to attach the severed tendon at the proper site. The proximal end of each cut tendon is also attached under slight tension to the corresponding adjacent tendon above, thus ensuring some slight degree of individual motion, a result somewhat surprising to me.

All hæmorrhage is carefully stopped, and it has been my custom to leave in the wound a small amount of iodoform powder suspended in ether. The incision is closed without drain-

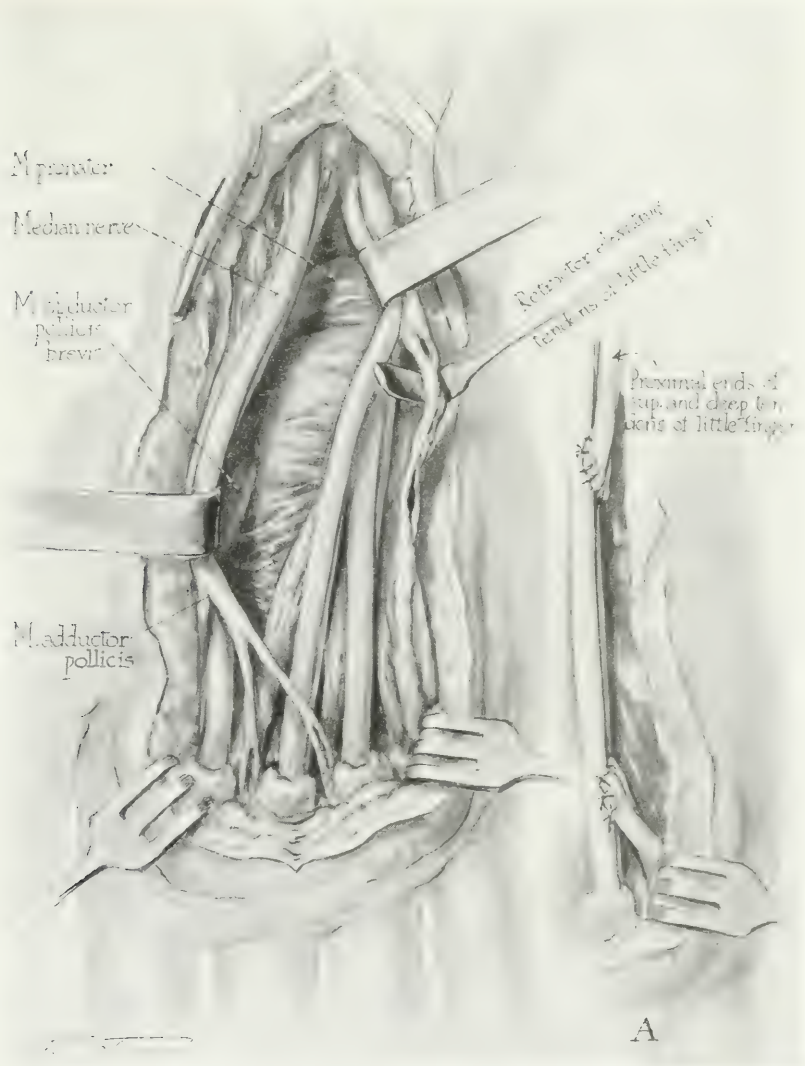

Fig. 12. Appearance of tendons after the removal of the tuberculous tissue. *A*, plastic repair of fragmented tendon.

age. No splint is applied, and the patient is told to use the hand for ordinary simple duties as soon as it is healed.

Under this treatment none of these nine patients has had a recurrence and all have practically complete function of their hands, with the exception of the cases in which the tendons have been excised. Due to the plastic procedure mentioned, these cases have very little disability. The photographs presented show the after-result in some of these patients.

In two patients, as noted above, tuberculosis was subsequently found in other tendon sheaths. In one case (O., Wesley Memorial Hospital No. 46977, Fig. 6), tuberculosis of the tendon sheath of the index finger was discovered six years after the operation upon the ulnar and radial bursæ. Whether this was present at the time of the primary operation and developed slowly, or whether it developed subsequently cannot be said; but it is certain that there was no recurrence in the palm or

forearm. This was a particularly favorable case for observation since the patient was a shoemaker, and while he refrained for a year from using his hand strenuously, he worked at his trade throughout that time, and during the next 5 years used it as he had always done, without any attempt to favor it.

The other patient (R., Wesley Memorial Hospital No. 92541), returned 6 weeks after operation with evidence of a tuberculosis of the sheath of the tendons of the ring finger. Here it is certain the lesion was present at the time of the first operation and overlooked. He also had a nodule on the skin of the forearm at the elbow. This was removed at the time of the first operation. He also has remained entirely well to date, a period of more than 2 years.

My experience with tuberculosis of the tendon sheaths of individual fingers is limited to the two patients just mentioned. In one there was a tuberculosis of the tendon sheath of the ring finger and in the other of the index finger. The former presented the typical proliferation of tuberculous granulation tissue upon both the parietal and visceral surfaces of the sheath, the history stating that this was more extensive upon the superficial than upon the deep tendon. Rice bodies filled the cavity. Under local anæsthesia an incision was made upon the flexor surface, from the distal flexion crease of the palm to the distal end of the middle phalanx. The entire sheath was dissected away and the tuberculous tissue dissected from the tendon. Fortunately fragmentation of the tendons was not present. The wound was closed and the patient permitted to use the finger as soon as the primary wound was healed. A complete functional result was obtained, as will be seen by examining the photographs (Fig. 1).

The other patient had suffered for some time with tuberculosis of the tendon sheath of the index finger, and in addition has an involvement of the proximal interphalangeal joint and the distal end of the proximal phalanx. Here it seemed advisable to amputate the finger at the metacarpophalangeal joint, and remove the tendons for some distance proximal to this point. An uneventful recovery ensued, and there has been no recurrence of the tuberculosis during the 2½ years that have elapsed since this operation.

These two cases typify the procedure to be followed. If there is no involvement of bone or joint, and the tendons are not so fragmented as to demand removal, a complete dissection of the tuberculous material will end in recovery, but if any complications are present, amputation should be the operation of choice.

My experience with cases with tuberculosis of the dorsal tendon sheaths in which adequate records were kept and in which I have been able to follow the results over a fair period of time is confined to four patients. Unfortunately the results have not been so satisfactory as with tuberculosis of the flexor sheaths. This was due in one case to incomplete excision and in another to poor judgment in the choice of the type of the treatment.

In two patients the removal of the tuberculous tissue resulted in permanent cures. One patient, in whom a recurrence took place (B., Wesley Memorial Hospital, No. 79844), was suffering at the time of operation from an incipient pulmonary tuberculosis which was suspected but not proven. Some weeks after operation the pulmonary involvement became evident and, later, other sheaths upon the dorsum of the hand became involved, or a recurrence took place at the site of the earlier involvement. Personal examination was not possible, but the history obtained seemed to justify this assumption. At operation no rice bodies had been found; the process seemed to be more acute than usual, and in view of the probability of lung involvement, I believe that immobilization of the wrist, supplemented by hygienic treatment, would have been the better treatment.

The other patient (S., Wesley Memorial Hospital No. 94649), suffered from a typical tuberculosis of the dorsoradial sheath (Fig. 9). Rice bodies had ruptured from the tendon sheaths into the surrounding tissue. Here, resection was attempted, but was not completely carried out, so that a recurrence with sinus formation ensued. The hand was then treated by sun baths and immobilization, with apparent recovery after 9 months.

The history of this patient emphasizes the difficulty of complete dissection of the dorsal sheaths. This can be secured only by the most painstaking endeavor. The sheaths are multiple and pass under the dense posterior annular ligament through separate compartments. These tunnels should be incised, and every vestige of tuberculous tissue including fragmented tendons should be removed.

It is a pleasure to acknowledge the assistance of my associates, Dr. Sumner Koch and Dr. W. H. Woolston in following up the patients and verifying the records.

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ADENOMYOMATA INVOLVING THE SIGMOID[1]

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SPENCER, in discussing a paper by Lockyer, in 1913, was the first to refer to a case of adenomyoma of the sigmoid. In this case there was a tumor about 2.5 centimeters in diameter, involving the serous and muscular coats of the sigmoid colon. In 1914, Leitch reported the case of an unmarried woman, aged 33 years, whose chief complaint was constipation and dull abdominal pain. At operation a loop of the sigmoid was found adherent to the back of the uterus in the pouch of Douglas. There was a small tumor at the point of contact which felt cancerous. On resection of the involved sigmoid, it was found that the tumor did not invade the mucous membrane. There was a small patch of adenomyomatous tissue on the surface of the uterus where the sigmoid was adherent. Meyer, in 1919, reported a case in which operation had been performed by Mackenrodt in 1907, for stricture of the bowel, in a single woman aged 45 years. The sigmoid colon was resected. In the center of the specimen, the lumen of the bowel was reduced to a mere slit; the tumor invaded the lumen as a polyp. The outer layers were much thickened, particularly on the mesocolic side. In 1920, Cullen reported two cases of his own and discussed two cases from the literature. Cullen's patients were 26 and 36 years old respectively, and neither of them had borne children. They both gave histories of severe dysmenorrhœa with abdominal pain and rectal distress at the time of menstruation. Both had definite adenomyomata in the sigmoid, and one of them had a separate adenomyoma in the rectovaginal septum. Sampson recently reported 12 cases of adenomyoma involving the intestinal tract; 5 of these were in the sigmoid: the others involved the rectovaginal septum, the appendix, and the small intestine. In these 5 cases the average age of the patients was 39 years; the youngest was 28 and the oldest 47. All complained of dysmenorrhœa, and all had noted a recent increase, or the occurrence of dysmenorrhœa associated with constipation.

Since January 1, 1911, 5,970 patients with fibromyoma of the uterus have been operated on at the Mayo Clinic. During these years operations have been performed on 494 patients with adenomyomata, of which 464 were in the uterus, fallopian tubes, ovaries, and uterine ligaments, 14 in the rectovaginal septum, 6 in the abdominal wall, 5 in the sigmoid, 3 in the inguinal region, 1 in the umbilicus, and 1 entering the wall of the bladder. Of the 5 cases involving the sigmoid, 1, Case 1 of our series, has been reported by Mahle and MacCarty.

Case 1. (A250372.) Mrs. J. A. M., age 31 years, came to the Clinic, November 7, 1918, because of a tumor of the lower bowel which had been found about 2 months before, when she had undergone an operation for pelvic tumor. At that time her appendix, both tubes, the left ovary, and a cyst from the right ovary, had been removed. She had been married 11 years, and had been pregnant once.

Roentgenograms of the colon and proctosigmoidoscopic examination were negative. At operation, November 14, 1918, a mass was found encircling the sigmoid, and involving a segment of bowel 4 centimeters long. The sigmoid and bladder were adherent to the uterus. Twelve centimeters of sigmoid, and tarry cysts from both ovaries were resected. The growth in the sigmoid was definitely adenomyoma (Fig. 1). The patient reports that she is now well and that her bowels move normally.

Case 2. (A295677.) Miss M. R., age 46 years, came to the Clinic, November 5, 1919, complaining of a dull pain across the lower abdomen. In June, 1914, a subtotal hysterectomy and left salpingo-oophorectomy had been performed because of fibromyomata and inflammation in the left tube and ovary. A stricture of the lower bowel, believed to be inflammatory, was noted at this time. In September, 1914, a colostomy was performed because of acute intestinal obstruction. The surgeon believed that the lesion in the sigmoid was malignant and immediate resection was advised.

At the time of examination, the patient still had dull gnawing pain across the lower abdomen. She was small and slender, but had not lost weight.

[1] Submitted for publication May 7, 1923.

Fig. 1. Case 1. Typical glands of endometrial type surrounded by stroma. (x 50.)

Fig. 2. Case 2. Glands lying in a rather cellular stroma. (x 50.)

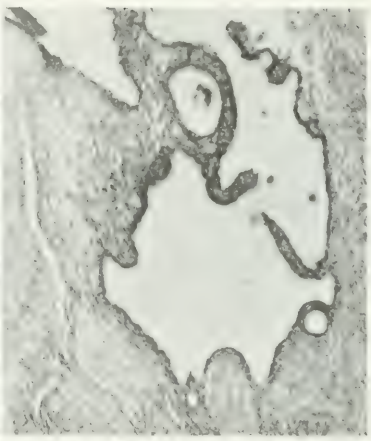

Fig. 3. Case 3. Photomicrograph showing dilated gland spaces. (x 50.)

The Wassermann reaction was positive. A satisfactory roentgenogram of the colon could not be obtained because of the colostomy. Proctosigmoidoscopic examination revealed marked narrowing of the lumen of the bowel to one quarter normal size at the rectosigmoidal juncture. The mucous membrane was intact. The narrowing appeared to be due to pressure outside the bowel. November 5, 1919, 9 centimeters of the upper end of the rectum, and 2.5 centimeters of the lower sigmoid was resected, and an end-to-end anastomosis made. An adenomyoma, 2.5 centimeters in diameter, was found 1.5 centimeters from the distal end of the sigmoid (Fig. 2). The mucous membrane was not involved. The patient's recovery was uneventful and after 6 months' rest at home, she returned to the Clinic, and the colostomy was closed. She now reports that she is in good health.

Case 3. (A314099.) Mrs. W. C. F., age 41 years, came to the Clinic April 29, 1920, complaining of pain in the lower abdomen following menstruation. She had developed endocarditis at the age of 15 years, and had always been in rather poor health. Her menses had been regular and not unusual until 2 years before, when she commenced to have pain about the third day, when clots passed, but pain continued for 3 or 4 days after the flow ceased. She sometimes had severe pain in the rectum with residual soreness for several days. She had never been pregnant.

Her heart was found to be slightly enlarged, with the apex 11.5 centimeters to the left. The first sound was greatly accentuated. A mass was found extending up from the pelvis into the abdomen. May 6, 1920, under ether anæsthesia, the abdomen was opened and the mass was found to consist of uterine fibromyomata, and an adenomyoma involving the sigmoid. The growth had passed between the peritoneum and coats of the muscle, but the membrane of the latter was not involved. The left ovary was cystic. Total abdominal hysterectomy, left oophorectomy, and salpingectomy were performed. The right ovary and tube were preserved. The adenomyoma was dissected from the wall of the sigmoid (Fig. 3). The pathologists reported multiple fibromyomata of the uterus, and cystic cervicitis. The largest tumor was 8 centimeters in diameter, and the smallest 3 millimeters. One fibromyoma was cystic and œdematous, and one was undergoing calcareous degeneration. There were polypoid endometritis and multiple adenomyomata of the uterus, the largest 6 centimeters in diameter. The tube contained many small, subserous cysts, and a small parovarian cyst, 1 centimeter in diameter. Cystic oophoritis of the ovary was noted. The patient made a good recovery.

Case 4. (A350044.) Mrs. D. S., age 48 years, came to the Clinic February 17, 1921, because of nervousness and menstrual pain. In 1911, she had had a partial hysterectomy on account of "tumors" and menorrhagia. She then remained well for a few months. Her menses were regular, lasting about a week at a time, with very scant flow, and accompanied by abdominal distress and soreness. She was constipated all the time, but more so during menstruation, when much flatus was passed. She had never borne children.

Examination revealed a hard mass filling the pouch of Douglas. At operation February 23, 1921, a hæmorrhagic cyst in the left ovary, bilateral chronic salpingitis, and a mass involving the sigmoid throughout its entire thickness were found. Both tubes, ovaries, and 12 centimeters of the sigmoid were removed, and an end-to-end anastomosis made. The pathologists found that adenomyoma involved the entire thickness of the sigmoid, over an area 6 by 4 centimeters, the greatest thickness being 2.5 centimeters (Fig. 4). The mucous membrane over this area contained multiple, small, polypoid elevations. The mass contained a fibro-

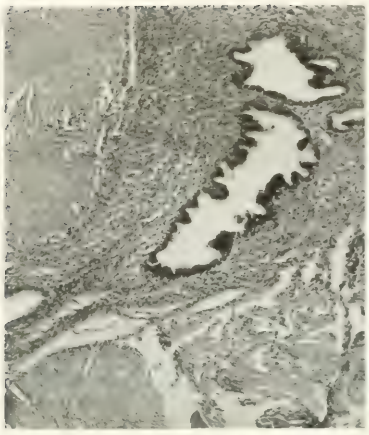

Fig. 4. Case 4. Adenomyomatous tissue from sigmoid. (x 50.)

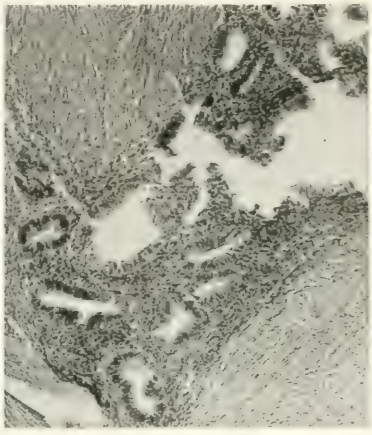

Fig. 5. Case 5. Well differentiated glands in typical stroma. (x 70.)

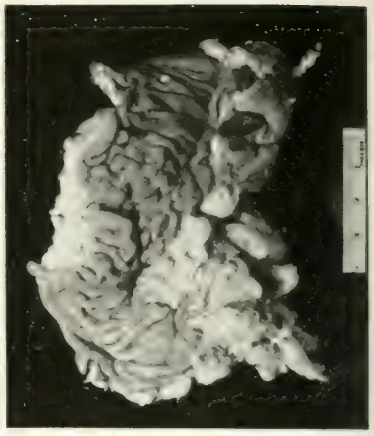

Fig. 6. Case 5. Gross specimen showing intact mucous membrane.

myoma, 5 by 4 by 4 centimeters, adherent to the serosa of the bowel. The left ovary contained a hæmorrhagic cyst, 7 centimeters in diameter, and there was bilateral chronic salpingitis. The patient now reports that she is well.

Case 5. (A415325.) Mrs. W. McK., age 45 years, came to the Clinic January 15, 1923. She had been well until 4 years before, when she began to be troubled with constipation, which was worse during menstruation and was associated with pain in the abdomen, particularly in the left lower quadrant, radiating to the back. Much flatus was passed. She had headaches and had lost her appetite. In April, 1920, she had no bowel movement for 5 days, although large doses of cathartics were taken. Pain in the lower abdomen was severe. There was some fever. A laparotomy was performed and an obstruction found in the rectosigmoidal region which was not thought to be malignant. A colostomy was made. For the first 2 months, all fæces came through the colostomy, but after that, about one-third came through the rectum, and the colostomy opening grew smaller. January 1, 1923, pain recurred, and bowel movement again became difficult. The patient had not lost weight. She had never been pregnant.

Examination revealed a small fæcal fistula at the site of the colostomy. Roentgenograms of the colon showed a filling defect in the rectosigmoidal region. Proctosigmoidoscopic examination as high as 24 to 30 centimeters did not reveal lesions in the mucous membrane. However, in the rectosigmoidal region the bowel was narrowed as if by pressure from without. At operation, January 10, a mass was found involving a loop of the small bowel, several inches of sigmoid, and the left tube and ovary. The mass felt malignant. The small intestine was separated from it, 15 centimeters of sigmoid together with the tube and ovary were removed, and an end-to-end anastomosis made. The pathologist's report was "adenomyoma with rather extensive infiltration into the wall of the sigmoid, chronic salpingitis and perisalpingitis, and a cystic oophoritis" (Fig. 5). The mucous membrane of the sigmoid was intact (Fig. 6). The patient's recovery was slow, but satisfactory.

ETIOLOGY

The etiology of adenomyomata has always been a debated question. The oldest theory is that they may have their origin in Mueller's duct inclusions. This was contested by von Recklinghausen, who claimed a mesothelial origin through the wolffian body. He admitted, however, that some of the uterine growths originate from an adult uterine mucosa, but believed that the occurrence of tumors in the broad and round ligament, and ovary, supported his theory. In 1896, Cullen definitely brought out and supported the theory that they arise in adult uterine mucosa. Pelvic inflammation has also been referred to as a causative factor. Ivanoff claimed that adenomyomata are the result of ingrowings of the peritoneal covering. Sampson has recently asserted that perforating hæmorrhagic cysts of the ovary give rise to these growths, and such cysts were found in the ovaries of all of his cases. It is noteworthy that cysts of various kinds were found in the majority of the other cases in the literature, and in our five cases. Bland-Sutton's recent work discountenances the Mueller and wolffian theories: he believes that adenomyomata originate from adult uterine mucosa. The evidence is confusing, and neither the position

nor structure of these tumors permits positive identification of their source.

DIAGNOSIS

Adenomyomata of the sigmoid, like those elsewhere, are most common between the ages of 35 and 45 years, in nulliparous women, or in those who have not borne children recently. In the 14 cases, in which age is recorded, it varies from 26 to 48 years, the average being 39 years.

A definite diagnosis is seldom made before operation. However, in most of our cases there was a history of dull pain in the lower abdomen, on the left side, associated with constipation, and which had lasted for 2 or 3 years. The pain and the constipation were definitely more severe during menstruation. At these times defæcation was often painful and in some instances associated with rectal spasm. There was seldom any loss of weight. Cachexia was not observed. Acute, or subacute, intestinal obstruction occasionally occurred; two patients in our series had had colostomies before coming to the Clinic. Physical examination revealed very little that was abnormal, except in some cases a mass in the left side of the pelvis which occasionally extended into the pouch of Douglas. Roentgen-ray examination revealed a filling defect in the sigmoidal region, but there was nothing distinctive in the picture. On proctosigmoidoscopic examination, the mucosa was found to be intact, but there was narrowing of the bowel and extraluminal pressure.

Adenomyoma of the sigmoid is usually confused with cancer of the sigmoid. It is difficult to distinguish it from early cancer before hæmorrhage, loss of weight, and cachexia occur. The longer course of the disease is evidence against malignancy. Diverticulitis of the sigmoid sometimes resembles these tumors in many ways. However, diverticulitis occurs twice as often in the male as in the female. A typical roentgenogram, when it is obtained in cases of diverticulitis, will make a definite diagnosis possible.

TREATMENT

The treatment of adenomyomata is entirely surgical. The symptoms and physical signs, although suggestive, are seldom, if ever, sufficient for a definite pre-operative diagnosis. As in other surgical conditions of the sigmoid and colon, a temporary colostomy should be made first, and an opportunity afforded for the patient to recover from obstructive symptoms that may be present. During this period, the lower loop of the bowel can be thoroughly cleansed by daily irrigations. A second operation, resecting the tumor, may then be safely undertaken; the results of such resection are usually good.

PATHOLOGY

Adenomyomata occurring in the sigmoid are similar to those occurring elsewhere in the body. They are gray, solid, and fibrous. The adenomatous portions of the tumor are glistening or dark brown (when hæmorrhagic) areas, varying in size from 1 to 2 millimeters to 1 centimeter in diameter. Microscopically, they consist of a stroma of connective tissue (of the endometrial type) and smooth muscle fibers, varying in proportion. Within this stroma there is glandular tissue or dilated spaces, lined with cylindrical epithelium, which resembles closely that of the endometrium. In certain sections there are evidences of hæmorrhages, both recent and old. Although these tumors rarely show evidence of malignancy, pathologically, and should be carefully distinguished from cancer by the regularity of the gland structure and the differentiation of the cells, they have marked infiltrative characteristics. On account of this marked tendency to infiltrate and recur, if not carefully removed, they are considered clinically malignant locally. They do not tend to metastasize.

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POSTOPERATIVE RENAL HÆMORRHAGE

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NEPHROTOMY is a conservative operation which should be free of danger, but as postoperative hæmorrhages appear in 10 to 12 per cent of the cases, it is evident that it is not quite so free from risk. Postoperative hæmorrhage may be of two kinds: primary, when it appears immediately or in 1 or 2 days after the operation, and secondary, when it appears on the sixth to twelfth day after intervention.

The pathogenesis of postoperative renal hæmorrhage is still discussed. Albarran (1) thinks that such hæmorrhages are the result of poor suture of the kidney; Rafin (16), on the contrary, believes that they are caused by the infection.

Langemak (11), de Hermann (7), Wildboltz (22), Frankel (5), de Kocher (9), Kortweld (10), and Papin and Morel (14) are of the opinion that a renal infarct is the cause of the hæmorrhage, but at the same time they state that the findings obtained from experimental investigation on dogs and hares are not always applicable to the human being. After operating on the kidney, Legueu (12) observed hæmorrhage in 16 cases and was obliged to do a nephrectomy. He made a complete examination of 12 of these cases and found the causes of the hæmorrhages to be as follows:

In 1 case the hæmorrhage was the result of the cutting of a vessel, and because of the profuse bleeding, he was obliged to do a nephrectomy the same day.

In 4 cases hæmorrhage was caused by the formation of an infarct at the site of the kidney incision. Legueu and Verliac think that suture of the kidney with catgut produces a leucocytic infiltration, an inflammatory reaction, and an anæmia which may lead to sphacelus when there is infection. To this may be added also the fact that because the anatomical disposition of the renal arteries, which are terminal, is not to produce infarcts, section must be done a little farther back on the convex edge; as this is difficult, Legueu believes that a small infarct is always the result of suture and section.

In 4 other cases, hæmorrhage appeared after pyelotomy and was again caused by an infarct as a result of the rupture of an abnormal artery. In 2 cases the hæmorrhage was also caused by an infarct as a result of the rupture of an abnormal artery after a nephrolithotomy.

The anatomopathological investigation carried out by Verliac, has proved that all the vessels which surround an infarct are congested, dilated, and most likely broken down. However, examination did not reveal rupture of any important vessels and hæmorrhage must have been from the small vessels.

In a single case only, the hæmorrhage was not caused by an infarct; the kidney presented distinct areas of nephritis and all around these foci of infection there was congestion, and the small vessels were ruptured.

Legueu says that, while infarct formation is nearly always fatal, it does not lead in all cases to serious hæmorrhage. He had an opportunity to observe an infarct which followed operation and was the result of

section of an abnormal artery, and though the patient recovered without late hæmorrhage, he thinks that in the presence of infarct and hæmorrhage, infection is the determining factor.

Rehn (18) concludes that hæmorrhage after nephrotomy is caused by circulatory disorders as the veins are distorted because after operation the kidney is left in its capsule without being fixed. To avoid this he proposes the following method of fixing the kidney: After the kidney has been returned to its capsule, with one hand the operator presses the inferior pole against the costal arc, and with the other hand sutures the kidney, using a big Hagedorn needle with thick double silk thread, traversing the skin and the muscular stratum at the inferior edge of the twelfth rib on the external edge of the sacrospinal muscle and passing through the middle of the inferior pole of the kidney which is vertical on the costal arc. The needle is then passed through the insertion of the diaphragm and comes out in the eleventh intercostal space at the superior edge of the twelfth rib. The ends of the threads are tied outside on a roll of bandage. In this way Rehn believes that it is possible to avoid hæmorrhage and even renal fistula after nephrotomy.

Rehn (19) studied this problem experimentally on dogs. In a group of experiments, he ligated the ureter without doing a nephrotomy. In all the animals he noticed a hyperæmia and hæmorrhage from congestion in the renal parenchyma. The author concludes that, after ligature of the ureter, the distention of the pelvis of the kidney produces pressure on the veins which form an acute angle, and it is necessary to consider what the effect will be of continued pressure of the urinary canaliculus and of a modification of the concentration of the urine. With the aid of the glomerulary apparatus we obtain complete cessation of the urinary secretion and it is for this reason that Rehn believes that the block pressure increases so suddenly and considerably in the arterial system. In the second group of experiments Rehn ligated the ureter in addition to doing a nephrotomy. In some cases a urinary fistula occurred and hyperæmia was not present; in others a fistula was not produced, and there was hyperæmia and serious hæmorrhage.

In the third series of experiments, (a) Rehn changed the position of the kidney after nephrotomy, and (b), in others for control, he fixed the kidney after nephrotomy. In the cases in which he changed the position of the kidney after nephrotomy all the animals died from secondary hæmorrhage, but he did not observe in any of these cases necrosis or renal infarct formation. In the other cases in which he fixed the kidney after nephrotomy, all the animals got well without the slightest hæmorrhage. From these experiments, Rehn concludes that late hæmorrhage after nephrotomy is caused by obstruction of the ureter (most often through blood clot), when the renal wound is nearly completely cicatrized.

To avoid these hæmorrhages he carefully sutures the parenchyma after each nephrotomy, fixes the kidney after his method, drains the pelvis of the kidney as well outside as in the bladder with a thick ureteral sound. He maintains that correct incision (Zondek or Marwedel) and careful suture of the parenchyma protect against primary hæmorrhage; to avoid late hæmorrhage he recommends physiological fixation of the kidney with careful drainage at the same time.

In addition to the causes mentioned, there are cases in which hæmorrhage is produced by a sectioned vessel. Perineau (15) had a case in which hæmorrhage appeared the twelfth day after nephrotomy. He immediately operated and found an arteriole in the cortical zone which was bleeding. He again sutured, placing his sutures deep and making them very tight and close together. After this the patient recovered.

Tuffier (21) published two cases in which immediate hæmorrhage was so abundant that it was necessary to ligate an artery.

Mayo-Robson (13), Sabatier (20), and Desnos (4), in cases exactly like these, have been obliged to do a nephrectomy immediately.

Rafin (17) observed a case of profuse hæmorrhage after pyelotomy, produced by the breaking down of a ligature from a severed arteriole that passed behind the pelvis of the kidney.

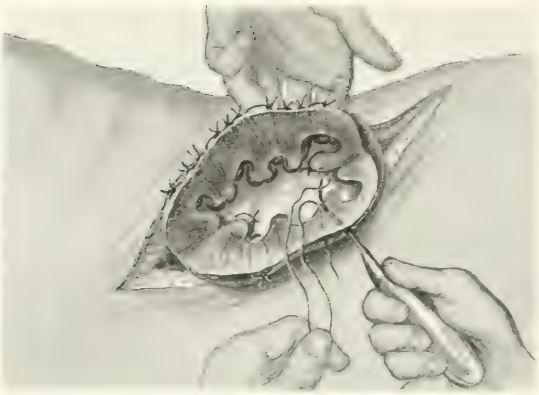

Fig. 1. Author's method of applying sutures.

Christian (2) reports a case with serious hæmorrhage after a nephrolithotomy, in which he was obliged to do a nephrectomy. The hæmorrhage was caused by the breaking-down of the eshars of the parts which were bruised during the intervention.

Zimmer (23) had a case with serious hæmorrhage after nephrotomy which necessitated immediate nephrectomy. In preparing for the operation, there was found a thick vein (1.1 centimeters) that went through all the superior part of the pelvis of the kidney, and which came in the area of the kidney incision. The author concludes that it is necessary to consider as important in making an incision in the renal parenchyma, not only the arterial distribution but also the venous circulation, for there are circumstances when the course of the large veins is of a special clinical importance.

Delbet and Mocquot (3) believe that the large veins that we cut when operating and which remain open, all help to produce hæmorrhage. To prevent hæmorrhage, Hagenbach (6) passes three sutures through the renal parenchyma. These are tied outside on small pieces of kidney fat. He believes that the sutures can be strongly tied in this way, without the danger of tearing the renal tissue.

I had the opportunity to operate in some cases of hæmorrhage after nephrotomy. In the first case a very profuse hæmorrhage endangering the patient's life appeared 6 hours after operation. I was obliged to operate a second time and found toward the superior pole of the organ a severed artery with a diameter of 1 millimeter which was the cause of this hæmorrhage. With the needle I passed a suture through the renal parenchyma. I tied the artery and the hæmorrhage stopped. The patient recovered soon after.

In another case I had to operate because of secondary hæmorrhage which appeared the sixth day and was repeated twice at the dressings. Opening the kidney I found that the hæmorrhage was coming from the veins of the renal parenchyma at the site of the drainage tube. I applied some U-shaped sutures, passing the stitches through the capsule and through the pelvis of the kidney. I tied these sutures and the hæmorrhage stopped. In the third case after a nephrolithotomy for numerous calculi of the kidney, with excessive hæmaturia, I observed immediately after the operation a rather abundant hæmorrhage, which forced me to open the renal sutures. At the site where I had taken out a calculus which was fixed in a small cavity in the renal parenchyma, was an ulcerated vessel which was causing the hæmorrhage. A circular suture that I passed through the parenchyma and tied afterward, stopped this hæmorrhage. I have observed hæmorrhage also after pyelotomy, and in these cases, there were again vessels in the coats of the pelvis which produced the hæmorrhage. Although these vessels are very small, when once tied, the hæmorrhage disappears.

Therefore I consider that primary or secondary hæmorrhage after nephrotomy is produced by cutting vessels of an organ eminently vascular, as the kidney.

Primary hæmorrhage I believe is caused by cutting the arterial branch; secondary hæmorrhage by cutting small arterioles or veins in the renal parenchyma which as a rule are at the level of the pyramid of Bertin; infection loosens the sutures, so that the thrombus which obstructs the vessel detaches itself.

To convince ourselves we proceed in the following way:

We expose the kidney and deliver it from the wound. Before incising it, we ask the assistant to press the pedicle with one hand, or we apply a forceps with elastic ends covered with rubber tube; afterward we section the renal paren-

chyma, and after thoroughly cleansing the incised surfaces of blood from the veins, we loosen the forceps gently, or we ask the assistant to release pressure on the pedicle in case he has produced hæmostasis. Thus we are able to observe immediately how the hæmorrhage comes from the sectioned vessels.

To prevent these hæmorrhages, which usually are stopped by suture of the kidney, but which reappear if infection occurs and causes loosening of the sutures, thus detaching the thrombus that obstructs the vessels, I proceed in the following way:

After delivering the kidney I apply a forceps to the pedicle or the assistant presses it. After incision and extraction of the calculus, I apply U-shaped sutures with a small Reverdin needle. The sutures pass on one side through the capsule, and on the other side through the mucous membrane of the pelvis. These sutures are usually passed at the level of the Bertin pyramids, where the cut vessels can be seen. Afterward we loosen the forceps, and look toward the superior or inferior pole, to see if there is any cut arterial branch. In case there is, we pass a suture through the parenchyma (Fig. 1).

If hæmostasis is good, only a few drops of blood that come out through the capillary vessels will be seen after the loosening of the forceps. Tightening of the sutures must be done with great care to avoid cutting the parenchyma.

In operating to remove numerous calculi which are situated in small cavities in the renal parenchyma, and which have produced abundant hæmorrhage before operation, we examine the bottom of that cavity. If we find an ulcerated vein we apply a circular suture all around the base of the cavity; we tighten this suture very gently and in this way, through compression of the parenchyma, we close the orifice of the ulcerated vessel. Afterward we suture the kidney according to the classical method and insert a drainage tube; the two ends of the threads which united the renal parenchyma near the drainage tube are passed through the muscle and tied, in this way fixing the kidney to the abdominal wall (Fig. 2).

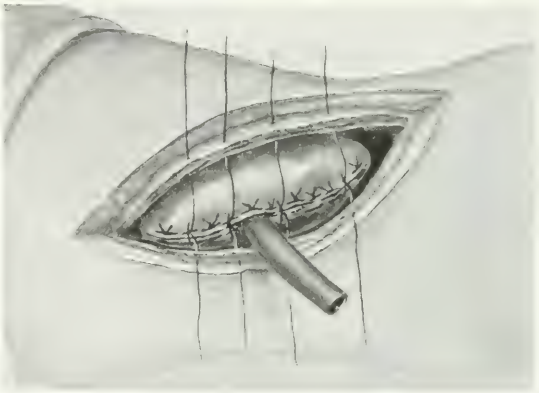

Fig. 2. Method of fixing kidney to abdominal wall.

When I began using this technique I no longer observed hæmorrhage primary or secondary. By the use of the U-shaped suture we always produce small renal infarcts but if hæmostasis is accomplished, hæmorrhage does not appear. In a case of nephrolithotomy in which I applied only two U-shaped sutures on the larger vessels, as I thought that the suture of the kidney would be sufficient to produce hæmostasis, after 8 days the patient had a violent hæmorrhage repeated twice, which necessitated a second operation. Toward the hilum I found two small arterioles which were bleeding. I applied two U-shaped sutures, applied drainage to the kidney and the patient recovered.

One might object that this method puts out of function a part of the renal substance which is between the U-shaped sutures. However, the amount of substance within the sutures is so small that it is scarcely of any importance, and we much prefer to lose a small part of the kidney, than to be obliged to do a secondary nephrectomy or to risk the life of the patient. I would advise the surgeon who does not wish to use this method of provisory hæmostasis, to use it in cases of secondary hæmorrhage after nehphrotomy, for they can be assured that the hæmorrhage will stop and it will not be necessary to do a nephrectomy.

Renal fistula heal much more quickly when this method is used. As blood clots that might decompose are no longer present in the pelvis the infection clears up more easily also. After an exploratory nephrotomy for hæmorrhagic

nephritis in cases in which it is necessary to carry out a decapsulation of the kidney, I believe the narrow strip of capsule, 3 to 4 millimeters in width, through which the sutures are passed, should be left on each side of the incision.

It is more difficult to secure hæmostasis in some cases, as in liberating the kidney the capsule has been broken, or the renal pedicle is short, the patient too fat, and the delivery of the kidney impossible.

CONCLUSIONS

We distinguish two kinds of hæmorrhages after nephrotomy:

1. Primary hæmorrhage which appears after a few hours or during the first day of the operation and is of arterial origin;

2. Secondary hæmorrhage which appears during the first 10 to 12 days after operation and is of venous or arterial origin. Concerning pathogenesis and treatment opinions differ.

a. Legueu, Papin, Morel, Langemak and Wildboltz, and others, believe that the hæmorrhages are caused by infarct formation which sometimes produces late hæmorrhages and is most probably influenced by infection.

b. Rehn believes that the hæmorrhages are the result of disturbance of circulation and secretion and recommends as a means of preventing them the physiological fixation and drainage of the kidney.

c. I affirm that hæmorrhage after nephrotomy is the result of the cutting of intrarenal vessels, and that infection causes at the same time the breaking down of the renal suture and the detachment of the clot that had been formed. To avoid these hæmorrhages I recommend that U-shaped sutures be used and passed through the cut surfaces of the kidney.

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THE PATHOLOGY AND TREATMENT OF CHRONIC LEUCORRHŒA[1]

A Further Clinical and Laboratory Study of This Subject

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In 1920 was presented a summary of my studies concerned with the pathology and bacteriology of chronic leucorrhœa,[2] together with a report of the therapeutic results obtained in 46 most recently treated patients. In contrast with previous experience, the results which had been obtained in that small series of cases were most encouraging, not only because of recovery of the patients, but especially in view of the fact that the treatment was based upon investigations concerned with the sources and nature of discharges and the pathological changes encountered in the tissues. It is desired, at this time, to report further experience in this work.

PATHOLOGY AND BACTERIOLOGY ASSOCIATED WITH LEUCORRHŒA

As previously recorded,[3] histological examination and bacteriological cultures of the entire ground endometrium, above the level of the internal os, rarely revealed evidence of infection in a study of uteri removed to remedy various pathological conditions. It appears that there is now general acceptance of the view that chronic infection of the body of the uterus is unusual; in the foremost clinics employment of the curette in attempts to relieve infection is considered a misdirected and harmful procedure.

In contrast, the cervix is believed to be an important focus of infection and the chief source of chronic leucorrhœal discharges. The pathology responsible for these discharges consists of redundant hypersecreting glandular tissue, often associated with insufficient drainage of the secretion (Fig. 1.).

The frequency and importance of cervical granulations and strictures requires further emphasis. Just as appendicitis formerly remained unrecognized and duodenal ulcer existed unnoted, these cervical lesions have usually been overlooked and, when recognized, their significance has been underestimated.

Further histological study of cervical tissues obtained from our service at St. Luke's Hospital confirms previous evidence in which most patients with chronic cervical leucorrhœa revealed cervical infection. There are, however, important exceptions to this; continued discharge may persist after disappearance of infection, provided there is extensive hyperplasia of gland tissue or partial obstruction of the cervical canal which interferes with drainage. In the event of disappearance of bacteria from the tissues, the cervix is no longer a focus responsible for ill health, other than that incident to mechanical annoyance from innocent discharge.

Bacteriological study of the endocervix does not closely parallel histological evidence. The tough sclerotic tissues are ground only with great difficulty and are not adapted to satisfactory bacteriological investigation. Scattered colonies of diphtheroid bacilli, bacilli of the colon group, some staphylococci, and varied anaerobes are encountered. From the standpoint of stubbornness of infection, gram-positive diplococci are most important. Examination of discharges, both in fresh preparations and in cultures, reveals that these bacteria, either aerobic or anaerobic, are found in notable numbers in about one-third of all patients with purulent leucorrhœa; they appear to be the chief cause of otherwise inexplicable puerperal infection which develops in patients with leucorrhœa.

Many a patient with profuse leucorrhœa of years' standing has no lesion other than persistent discharge from a sacculated Skene's duct opening in the floor of the urethral meatus. Usually the other Skene's duct is somewhat infected. Slightly higher in the urethra,

[2] Curtis, A. H. Chronic leucorrhea; its pathology and treatment. J. Am. M. Ass., 1920, lxxiv, 1706.

[3] Curtis, A. H. A combined bacteriological and histological study of the endometrium in health and in disease. Surg., Gynec. & Obst., 1918, xxvi, 178.

[1] Read before the American Gynecological Society, Hot Springs, Virginia, May 21–23, 1923.

the small urethral glands occasionally harbor infection, and pus can sometimes be seen exuding from a minute opening upon exerting suburethral pressure.

Some patients reveal no infection in the region of the urethra and examination indicates an essentially healthy cervix, yet leucorrhœa persists. It has never been evident that disease of the Bartholin glands or erosions implanted upon the vaginal walls can account for these cases. Heavy congested pelvic organs or deep-seated pelvic infection are assumed to be the underlying lesions in most instances, but accurate determination of the pathological process is often impossible.

METHOD OF TREATMENT AND RESULTS

Our treatment of chronic leucorrhœa previous to 1919 yielded distinctly disappointing results. Since that time 140 patients, including 46 previously reported, have been treated. This number does not include a very considerable group in whom office management has been sufficient to effect relief. Only the most severe and most chronic cases, all subjected to a trip to the hospital, are here considered.

The patient is given nitrous oxide anæsthesia. The vicinity of the urethra is searched for infected Skene's ducts and urethral glands. Diseased foci are threaded on the blunt end of a needle, the tract laid open with a knife, and lining fulgurated or otherwise cauterized.

Examination of the Bartholin glands and vaginal walls seldom indicates that these tissues participate in the disease process, although occasional discharging sinuses are traceable to an origin in the Bartholin glands.

Upper zone pelvic lesions, requiring surgical intervention, do not concern us at this time.

Cure of the diseased cervix may be achieved through radium application, which produces atrophy of the infected glands, or through removal of the endocervix. Surgical removal, according to the method of Sturmdorf, has yielded excellent results in those selected cases in which it has been employed. In our work, radium is given preference in patients with evidence of infection extending high into the cervical canal, in those with strictures in the vicinity of the internal os, in patients with profuse creamy discharge, in those whose cervix is inaccessible to surgery, and in instances where removal of the diseased tissues promises to require extensive or difficult operation. Wedge-shaped excision of the anterior lip, or other simply performed removal of diseased tissue, is often combined with the radium application. The fundamental requirement is that the patient be relieved of the diseased, discharge-producing tissues; further experience will best determine whether a given patient shall be treated with radium or subjected to removal of the endocervix.

The technique of radium treatment is as follows: The cervical canal is investigated with graduated dilators. Thorough dilation is made without producing laceration. Diagnostic curettage, separate for cervix and fundus, may be desired. Two 25 mg. tubes of radium, in tandem, are introduced into cervix and held in position by Michel clip at external os. The screen now used is a rubber-covered gold capsule, 0.5 millimeter in thickness. Younger women, with regular menstruation, receive application for 7 hours; treatment for this period of time never disturbs the normal menstruation. Patients over 35 years of age must be treated with greater caution.

The immediate result of radium treatment is increased discharge, which persists for many weeks. This stage is often followed by a stationary period of a month, or even 2 months. Meantime, the cervix should be dilated occasionally, at office, to prevent stenosis.

Gradual improvement is the rule; recovery after a single application is frequent, but a considerable number require a second radium treatment to effect a thorough cure. This is preferably postponed for several months, first, because one treatment may eventually prove to be sufficient, second, because it is desired to ascertain with certainty that radium has not interfered with the menstrual function. The dosage of the second application varies with requirements, but may almost always equal the amount first used, if desired. At this time attention should again be directed to Skene's ducts, which may not have been completely destroyed at the first treatment.

It should be particularly emphasized that several patients with long-standing leucor-

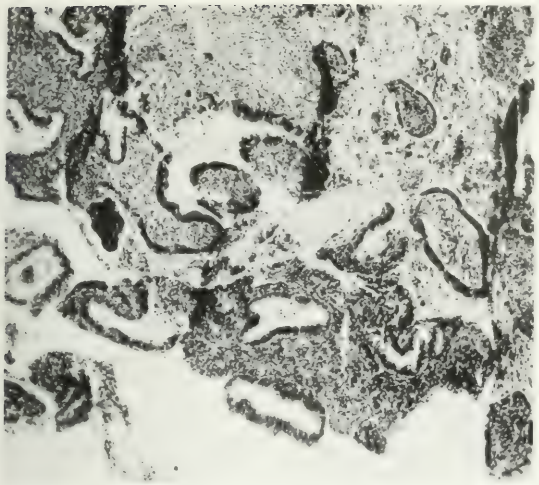

Fig. 1. Endocervix from patient with chronic leucorrhœa; showing overgrowth of infected hypersecreting glands.

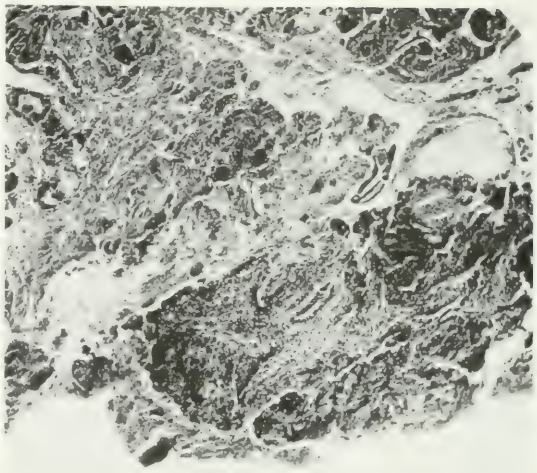

Fig. 2. Endocervix after recovery from chronic leucorrhœa. Radium has produced almost complete atrophy of the infected cervical glands.

rhœa, in whom the results of treatment appeared unsatisfactory, upon return 9 months or 1 year later revealed absolute recovery from their affliction. It is always advisable to state that the curative effect of the radium may not be manifest until this period of time has elapsed.

A total of 126 patients have been treated, but 22 of these have not been available for further study. Ninety patients have recovered (Fig. 2), seven are improved, and seven have not been benefited.

Of the 90 patients classed as "recovered," 6, after a normal course of one-half year or more, came back with history and evidence of freshly acquired infection. One of the chief difficulties in treating this affection is that the patient is often subjected to further exposure to disease or undergoes sexual trauma during the period of convalescence.

The 7 improved patients include 4 whose treatment has been interrupted or incomplete; no late report is available from 1; 2 will probably remain stationary.

Seven unimproved merit individual attention: (1) A patient with profuse creamy streptococcus-laden discharge revealed a widely open cervix, a fundus retroposed, slightly held by adhesions and containing a 4 centimeter fibroid, all pelvic tissues boggy and inflamed. Complete hysterectomy, after failure with other treatment, was followed by recovery. (2) A patient with considerable thin creamy discharge, unimproved after 2 years, gradually recovered after hysterectomy of a uterus which revealed slight evidence of diffuse cervicitis and metritis. (3) Leucorrhœa from a cervix left after removal of infected tubes, ovaries, and fundus, failed to yield to radium treatment. The discharge now persists 6 months subsequent to complete removal of the cervix. (4) A prostitute, who showed early signs of improvement, reports often for treatment, but subjects herself to renewed infection. Three other patients, two of whom show signs of pelvic cellulitis, have not been benefited by treatment.

COMMENT

Characteristic of chronic cervical disease is the symptom of leucorrhœa. Associated arthritis and general ill health are a frequent result; much more frequent than many have believed. The notable improvement in health and spirits of many who have recovered from chronic leucorrhœa has particularly impressed me with the importance of these low-grade infections.

The writer, in a recent study of diseased fallopian tubes, found that a single gonor-

rhœal infection of the tubes is of short duration. So-called chronic gonorrhœal salpingitis seems not to be a persistent infection but rather a recurrent process, in consequence of repeated ascent of gonococci from the lower genital tract or from an outside source. Streptococci, on the other hand, may remain viable in the tubes for many years. These observations are of interest in the present problem, for a study of chronic discharges reveals that gram-positive diplococci, which produce rich growth of streptococci in cultures, are characteristic of the most severe and most chronic leucorrhœal infections. In other words, it would appear that certain cases of leucorrhœa owe their resistance to treatment to the fact that streptococci invade the inaccessible cellular tissues of the pelvis and are capable of remaining viable for an indefinite period of time.

Another class of patients in whom either radium or endocervical excision offer only moderate prospect of relief are those with heavy displaced pelvic organs. Especially in the presence of a widely open cervical canal, procedures short of radical surgery fail to bring about recovery.

CONCLUSIONS

1. The sources of chronic purulent leucorrhœa can usually be definitely localized. These foci of infection are important factors in the production of systemic disturbances, as well as local distress.

2. Cervical discharges may persist after disappearance of infection; this is notably true if extensive hyperplasia of the cervical glands has occurred. Relief from these innocent discharges is not essential, provided they cause no mechanical annoyance.

3. Available measures in the control of chronic leucorrhœa consist in eradication of gland infection in the vicinity of the urethra, dilatation of cervical strictures, and destruction of hyperplastic glandular tissues of the cervix. Whether the latter is to be accomplished by endocervix removal or through the use of radium should depend upon the character of the pathology encountered, modified by the experience of the surgeon in charge.

4. Destruction of infected Skene's ducts and urethral glands, together with thorough dilatation and radium treatment of the cervix, has been followed by recovery from chronic leucorrhœa in 87 per cent of 104 patients.

BREECH PRESENTATIONS TREATED BY PROPHYLACTIC EXTERNAL VERSION

Report of Fifty-Nine Breech Presentations so Treated

By GEORGE HOPE RYDER, M.D., New York

BREECH presentations are always a source of worry to the obstetrician and a danger to the unborn child. The fetal mortality in breech presentations is much higher than in cephalic presentations. According to the standard textbooks on obstetrics, the fetal mortality following unconverted breech presentations ranges from 20 per cent to about 6 per cent, or from 1 in 5 to 1 in 16.

Thus Hirst, of Philadelphia, in his *Textbook on Obstetrics*, says: "The fetal mortality of breech presentations is about 20 per cent, including badly managed cases in general practice."

Williams, of Baltimore, in his *Obstetrics*, says: "The prognosis for the child is considerably worse than in vertex presentations, the fetal mortality being generally estimated at 10 or 15 per cent."

Peterson, of Ann Arbor, in *The Practice of Obstetrics*, says: "Ten per cent of the children are lost in primiparous women. Asphyxia is the cause of death. In multiparæ, however, the prognosis is about a third as bad. Some authorities, however, estimate the general fetal mortality as high as 20 per cent (Edgar)."

The *American Textbook of Obstetrics:* "The prognosis for the child is always poor, the mortality running as high as 10 per cent in skilled hands."

Cragin, of New York, in his *Practice of Ob-*

stetrics, states: "In a series of 835 breech presentations at the Sloane Hospital, in the first 20,000 deliveries, there was a complete fetal mortality, including abortions and macerated fetuses, of 302, or 36 per cent; of fetal deaths from the labor itself, however, there was less than 6 per cent." (The latter part of this statement is inaccurate, the corrected mortality making this last figure nearer $8\frac{1}{3}$ per cent.)

Polak, of Brooklyn, in his *Manual of Obstetrics*, says: "The mortality to the child, when the delivery is left to nature, is 10 per cent, at least in first labors; with skilled management, it is but little greater than in vertex births."

Potter, of Buffalo, the greatest exponent of internal version and breech delivery in this country, is reported to have said recently to a member of the Sloane Alumni Society, that his fetal mortality from breech deliveries following breech presentations, was 9 per cent in primiparæ.

Most of the authorities mention external version as a desirable prophylactic measure.

Polak says: "External version is permissible if it can be done without violence."

Hirst says: "Before labor, external version may be attempted. It will not always be found practicable, and after the fetal body has been turned, there is a disposition on the part of the fetus to resume its original position. The application of two long cylindrical compresses to the sides of the uterus, and a firm abdominal binder, may prevent a return of the breech presentation. When labor has begun, inaction should be the physician's policy. . . . "

Cragin says: " . . . it is usually wise to attempt the conversion of the breech to a vertex presentation before labor. . . . In multigravidæ with lax abdominal and uterine walls this conversion can often be accomplished with ease by external version. . . . If the patient is a primigravida, with tense or very fat abdominal wall, or if the fetus is very large and the breech is low in the pelvis, external cephalic version is much more difficult, and sometimes without an anæsthetic is impossible. Under an anæsthetic, the version is usually easy, and the difficulty consists only in maintaining the corrected presentation. If the head is placed well within the brim of the pelvis, and there is no abnormality present, the fetus will often stay in cephalic presentation. Disappointments, however, are not uncommon. . . . The corrected presentation can sometimes be maintained by an abdominal binder, but occasionally all efforts in this direction fail and the presentation is best left as a breech."

TABLE I.—BREECH PRESENTATIONS

Total number consecutive deliveries	890	
Total number breech presentations	59	1 to 15
Primiparæ	24	40.6%
Multiparæ	35	59.3%
Viable fetuses	52	88.1%
Non-viable fetuses (all under 7 months, 2 macerated)	7	11.9%

Williams says: "In view of the serious fetal prognosis attending breech presentations, the obstetrician should aim to prevent their occurrence as far as possible, and whenever they are diagnosed, in the later weeks of pregnancy, an attempt should be made to substitute a vertex presentation by means of external version. This is readily accomplished in multiparæ with lax abdominal walls, but is much more difficult in primiparæ. If there is no serious disproportion and the head can be forced into the pelvis, after the substitution has been effected, the new position becomes permanent, but if engagement fails to occur the child will usually revert to its original position, notwithstanding the application of a properly fitting bandage. In the former case the result is usually excellent, and affords striking proof of the value of routine antepartum examination. External version may also be attempted in the first stage of labor, provided the breech has not descended deeply into the pelvis; but when it has once become fixed, all such efforts are unavailing, and it is best to leave the case to nature, and be prepared to interfere when necessary."

Realizing the dangers of breech deliveries, even in normal pelves, the writer has for years followed the plan of converting all breech presentations, when practicable, into vertex presentations, by external version. Under this plan of treatment, the following series of breech presentations is offered.

In 890 consecutive deliveries in private practice, there were found 59 breech presentations, approximately occurring in the proportion of 1 to 15. Twenty-four of these were in primiparæ, and 35 were in multiparæ. These 59 breech presentations naturally fall into three groups when treatment and results are considered.

1. *The non-viable.* Of these there were 7. Spontaneous delivery took place before the seventh calender month, or more than 8 weeks from term. Two in addition were macerated. Under no method of delivery could any of these be saved; presentation was of no significance; and no attempt was made to change the presentations, either at the time of labor or previously.

TABLE II.—TREATMENT

Non-viable, no attempt at treatment, 7 cases
Viable under observation before labor, 49 cases

	External version	Failure at attempt at version	No attempt at version	Total
Normal	20	0	0	20
Forceps	7	0	0	7
Breech	1	1	16	18
Cæsarean section	1	3	0	4
Total	29	4	16	49
Version with anæsthesia	6	0		
Without anæsthesia	23	0		
Fetus living	29	0	0	
Fetus dead	0	0	0	

Viable, not under observation before labor, 3 cases

	External version	Left as breech	Total
Forceps	1	0	1
Breech	0	2	2
Total	1	2	3
Version with anæsthesia			1
Fetus living			1
Fetus dead			2

2. *The viable under observation before labor.* There were 49 of these, delivery taking place within 8 weeks of term.

3. *The viable not under observation before labor.* These were 3, delivery taking place within a few weeks of term, but none of them having been seen before labor.

Obviously, it is in the management of the second group, that of viable fetuses under observation before labor, that most should be expected from prophylactic treatment by external version; for, in the first group, the non-viable, it was too early for such treatment; and in the last, the viable not under observation before labor, it was mostly too late. It is to the second group, therefore, that special attention is directed.

The management of these 59 breech presentations (in the various groups) was as follows:

For the first group, the non-viable, there was no treatment, or attempt at treatment, as mentioned.

The method of treatment of the second group, the 49 viable fetuses under observation before labor, was the following: External version was performed on 29 of the 49 patients—considerably more than half. After the 29 external versions, deliveries were as follows: 20 were delivered normally, 7 were delivered by forceps, 1 was delivered by the breech, after spontaneous reversion, 1 was delivered by cæsarean section. This patient had a small pelvis and external version was performed at the seventh month. During the next 2 months, the head did not settle down into the pelvis, but remained high. Moreover, it could not be crowded down into the pelvis. At operation, a marked projection of the promontory of the sacrum was found, which would have made natural labor impossible. It was felt that, in this patient, disproportion of the head and pelvis could not have been so easily made out, if the presentation had remained a breech. This seems to the writer to be one distinct advantage of early external version.

After these 29 external versions, then, there were 20 normal deliveries, 7 forceps deliveries, 1 breech delivery, and 1 cæsarean section. All of these 29 fetuses lived.

On 4 women of this same group, external version was tried and failed. Three were elderly primiparæ near the age of 40. These 3 were delivered by cæsarean section. The fourth was a young primipara later delivered as a breech. These 4 fetuses lived.

In the remaining 16 patients of this group, no attempt at external version was made, delivery in all of them being by the breech. The reason why external version was not tried, will be seen. In 5, labor started prematurely, before an attempt at external version was decided upon; in 4, 4 weeks from term, and in 1, 2 weeks from term, the day after the patient returned from the country. Eight were one of twins, where external version was contra-indicated. Three were multiparæ at term, 2 with spontaneous version

TABLE III.—MONTH OF EXTERNAL VERSION

	Sixth	Seventh	Eighth	Ninth	Total
Primiparæ	0	2	3	3	8
Multiparæ	3	8	9	2	22
Total	3	10	12	5	30

TABLE IV.—COMPARISON OF MULTIPARÆ AND PRIMIPARÆ

	Multiparæ	Primiparæ	Total
Non-viable	5	2	7
Viable			
External version	21	9	30
Failure of attempt at version	0	4	4
No attempt at version	9	9	18
Total viable	30	22	52
Method of delivery			
Normal	17	3	20
Forceps	3	5	8
Breech	10	10	20
Cæsarean section	0	4	4
Total	30	22	52

vertex to breech in the first stage of labor; and 1 a lateral placenta prævia, left as breech for safety. These 16 fetuses lived.

Of this whole group, then, 49 viable fetuses under observation before labor, there was no fetal mortality.

Of the third group, composed of 3 viable fetuses not under observation before labor, all were seen for the first time in consultation.

The first patient was a young primipara in the first stage of labor, with poor pains and with the breech still high. Under ether this was turned to a vertex. Several hours later, chiefly because of inertia, delivery was made by forceps. The child was in good condition and lived.

The second patient was an elderly primipara, neglected, 2 weeks past the estimated date of confinement, already in labor 36 hours with ruptured membranes when first seen. Cæsarean section and external version were both out of the question because of the long dry labor and the many vaginal examinations. Delivery was accomplished only after a craniotomy on the after-coming head of a dead fetus.

The last patient of the three had a complete placenta prævia, and was seen for the first time after a furious hæmorrhage a few weeks before term. She was an elderly multipara just starting in labor. Delivery was effected a few hours later by an easy breech extraction, without harm to the mother, but with a dead fetus. Death seemed to be due to the placenta prævia, not to any dystocia.

Thus it will be observed that in the whole series of 59 breech presentations treated by prophylactic external version, where possible and feasible, the only fetuses lost were the non-viable and two not under observation before labor. Conversely, there were saved of viable fetuses, all under observation before labor and one of the three not under observation before labor.

To summarize:		
Total series of breech presentations	59	
Fetuses lost—all causes		
Non-viable	7	
Viable	2	
Total	9	15.2 per cent
Total number of viable fetuses	52	
Viable fetuses lost	2	3.8 per cent
Total number of viable fetuses under observation before labor	49	
Fetuses lost	0	

Of all the 30 women on whom external version was performed, in none of the primiparæ did the fetus turn back to its original presentation. In several of the multiparæ this did happen, but all were easily returned to the vertex except two.

TABLE V.—FULL TERM BREECH DELIVERIES (EXCLUSIVE OF TWINS)

Multiparæ	5
Primiparæ	3
Total	8

In one, the fetus returned to the breech presentation in the first stage of labor, and the patient was not seen till labor was too far advanced for a reposition. This patient had a slightly flat pelvis, and previous to labor external version had been performed several times, each time the fetus returning to a breech.

In the other multipara, external version was performed four times, the fetus returning each time. Finally in the first stage of labor, under ether the fetus was turned to a vertex and held there until the membranes were artifically ruptured. Normal labor followed in a few moments, after the patient came out of ether.

Twenty-three of these external versions were performed without anæsthetic. Seven were performed under ether, 3 in primiparæ and 4 in multiparæ. All the versions were performed before labor except two, one in a primipara and one in a multipara, each in the first stage, under ether, in the ninth month.

By far the greater number of versions were done in the seventh and eighth calendar months. Thus in the sixth month there were 3 in multiparæ without ether. In the seventh month there were 2 in primiparæ and 8 in multiparæ, all without ether. In the eighth month there were 3 in primiparæ without ether, and 9 in multiparæ, 3 with and 6 without ether. In the ninth month there were 3 in primiparæ, all with ether, and 2 in multiparæ, 1 with and 1 without ether. In other words, 22 out of the 30 versions were performed in the seventh and eighth months, with 3 in the sixth and 5 in the ninth.

There was no maternal mortality in the series and in no case, with one possible exception, did the external version seem to do the slightest injury to the mother. The exception was one woman in whom bleeding from the vagina was seen following the version. This did no further harm, however. Labor started promptly, was short and natural, and mother and child were entirely normal at its conclusion. The bleeding was probably due to undue force in doing the version, because of poor relaxation from a difficult anæsthesia, and probably came from pressure on the edge of the placenta.

In doing the version, it is found necessary to have the patient's bladder empty. If the breech can first be pushed up from the pelvic brim, the rest of the version is usually easy. To this end,

it may be useful to have the patient assume the knee-chest position, just before the attempt at external version is made.

No mechanical appliances were used to retain the fetus in its corrected presentation, as it was not thought that these would be of any value.

The 8 forceps operations following the 30 external versions were 2 high, 1 medium, and 5 low. None of these was difficult.

There were 4 cæsarean sections in the series. 1 after external version and 3 after external version failed. External version failed in 4 of 34 patients on whom it was tried.

Because of external versions, in the whole series of 59 breech presentations, there were, excluding twins, only 8 full term breech deliveries; 3 in primiparæ and 5 in multiparæ. Excluding those seen in consultation there were only 6; 2 in primiparæ and 4 in multiparæ.

The cord was found once around the neck of 5 fetuses delivered as vertex after external version; also of 1 fetus delivered as a breech without external version. In no instance did the cord thus around the neck do the fetus any harm.

CONCLUSIONS

The safest method of treating breech presentations is by prophylactic external version.

External version not only reduces the fetal mortality, but renders labor shorter and more natural for the mother.

The operation is safe, if done without force.

The best time for performing external version is usually the seventh and eighth calendar months.

The operation is generally quite easy and may usually be performed without ether.

When at all difficult, a general anæsthetic should be used. Under this, in most cases, except late in labor, external version is easily performed.

Force should never be used. If version can not be accomplished without force, the operation should be given up.

When external version is once performed, the fetus occasionally resumes its original presentation, but usually does not. This is more likely to occur when the version is very easy. Consequently, the fetus may be re-turned as frequently as necessary, even early in labor. When external version is difficult, spontaneous reversion is not apt to occur.

External version performed early gives warning of disproportion between the head and the pelvis, by observation of the way in which the head settles into the pelvis or may be crowded in by the obstetrician.

Finally with careful observation in the latter months of pregnancy, external version should reduce the fetal mortality of breech presentations approximately to that of cephalic presentations; and furnishes one more argument for careful antepartum examinations.

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RETROPERITONEAL OPERATION FOR SUBPHRENIC ABSCESS

With the Report of Two Cases

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UP to the present time subphrenic abscess has been a very much feared complication in the field of abdominal surgery. The diagnosis and the treatment are usually most difficult.

Barlow (1) in England (1845) and Leyden (2) in Germany (1886) were the first to describe the clinical picture of subphrenic pyopneumothorax and were the first to distinguish it from the diseases of the thorax. Their clinical description is as follows: Above the liver dullness is found a tympanitic zone which in turn is covered by a zone of dullness produced by a pleural exudate. The tympany results from free gas in the peritoneal cavity which is found in only about one-third of cases with abscesses in the subphrenic region. This classical picture represents only the minority of cases and when present is not infallible, because as Beclère (3) in France (1899) has shown the tympanitic zone can be produced by a highly situated, gas-distended, transverse colon.

In those cases of subphrenic abscess where the gas is absent, the diagnosis is still more difficult because an increase in the liver dullness upward, produced by the presence of a collection of pus above the liver, is easily confused with a pleural exudate. This is especially true in those frequent cases in which a pleural exudate co-exists.

There are other cases in which the abscess is located below the liver instead of upon its upper surface, which are even more difficult to diagnose because the increased liver dullness is lacking.

ANATOMY

To understand the sites of election of secondary subphrenic abscesses, it is imperative that one be well acquainted with the topographical anatomy of the upper abdomen.

Martinet (7) (1898) and Piquands (11) (1909) in France and Barnard (2) (1908) in England have especially worked out the topographical anatomy of the subphrenic region. Martinet (7) divided this region into six spaces: two interhepatodiaphragmatic spaces located between the upper surface of the liver and the diaphragm, one on each side of the midline, a subhepatic space located on the under surface of the liver to the right of the hepatoduodenal ligament, an interhepatogastric space located beneath the liver and anterior to the lesser omentum, a retrogastric space located posterior to the lesser omentum and a perisplenic space located around the spleen.

The classification according to Barnard (2) is similar to that of Martinet (7). He described on the right side an anterior subphrenic space located between the liver and diaphragm and a posterior subphrenic space in the subhepatic pouch on the under surface of the liver; on the left side a perigastric anterior to the lesser omentum, a perisplenic and a space in the "small sac of the peritoneum."

On account of the confusing terms existing in the literature and the overlapping of the various spaces described, one of us has worked out the following anatomical classification which is described in detail in a previous publication (Figs. 1, 2, 3).

According to this classification the various spaces represent the sites in the upper abdomen where a secondary abscess may develop and each space is purposely so named so that its name describes its location. By the subphrenic region is meant that space located between the diaphragm above and the transverse colon and the transverse mesocolon below (Fig. 1), which is divided by the liver into an upper and lower space and by the falciform ligament into a right and left (Fig. 2). These four main spaces are subdivided as follows:

a. There remains a small, yet very important, space: *the right upper posterior space*,

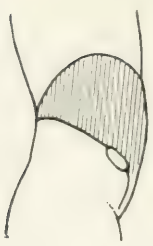

Fig. 1.

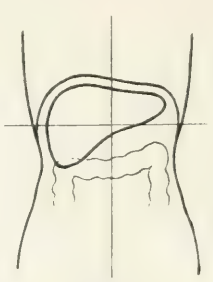

Fig. 2.

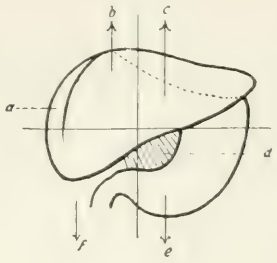

Fig. 3.

Fig. 1. Schematic lateral section showing the diaphragm above and the transverse mesocolon below as boundaries of the surgical subphrenic region.

Fig. 2. Schematic anteroposterior section showing the division of the suphrenic region into the four main spaces.

Fig. 3. Schematic representation of the spaces in the subphrenic region. The transverse line on the upper surface of the liver, which on the right side lies partly anteriorly (solid line), and on the left side lies posteriorly (dotted line), represents the coronary ligament. The right extremity of the coronary ligament (solid line) is the triangular ligament which divides the right upper space into a large anterior and a small posterior space. *a*. Right upper posterior space; *b*, right upper anterior space; *c*, left upper space; *d*, left lower posterior space (lesser peritoneal cavity); *e*, left lower anterior space; *f*, right lower space.

located on the posterior lateral surface of the liver between it and the diaphragm, which will be especially considered in this paper as we wish to deal only with those subphrenic abscesses complicating appendicitis.

b. *Right upper anterior space* located between the upper liver surface and the diaphragm anterior to the right triangular ligament.

c. *Left upper space* located between the liver and diaphragm on the left side.

d. *Left lower posterior space* which is the lesser peritoneal cavity.

e. *Left lower anterior space* beneath the liver and anterior to the lesser omentum and stomach.

f. *Right lower space* located on the under surface of the liver to the right of the lesser peritoneal cavity.

g. Perisplenic space in the region around the spleen.

Experience shows that the subphrenic abscesses complicating appendicitis are as a rule located in the *right lower* or the *right upper posterior space* or *both*.

ROUTES OF INFECTION

There are three possible ways in which the infection arising in the appendix may proceed to the subphrenic space.

1. Intraperitoneally along the ascending colon up to the liver, resulting in abscesses located intraperitoneally. These constitute about 50 per cent of the cases. (Nather, 9.)

2. The infection ascends posterior to the ascending colon in the loose retroperitoneal connective tissue, past the kidney up to the liver. These abscesses lie retroperitoneally.

3. Pyelophlebitis with origin in the mesenteric veins, resulting in a liver abscess and later perforation of the liver abscess into the perihepatic spaces.

DIAGNOSIS

The diagnosis of a subphrenic abscess following appendicitis is easy, if one bears in mind the possibility of its development and is on the lookout for the appearance of a pathological process in the spaces mentioned.

To consider the possible occurrence of a subphrenic abscess in a case of appendicitis, the postoperative course of which deviates from the normal is often equivalent to the making of the diagnosis.

As a complication after appendectomy a subphrenic abscess can develop within a few days or it may be weeks after the operation that the first symptoms appear. As a rule the abscess is, within 1 to 2 weeks, so far advanced that it can be easily recognized.

Even at the original operation, it is often possible from the findings to predict the probable development of a subphrenic abscess, i.e., a highly located, badly infected appendix; retrocæcal or appendiceal abscess; early peritonitis, etc.

When such an abscess develops the *general* symptoms are the first to be observed. The patient does not recover after the appendectomy. The temperature does not fall as should be expected, or increases without an apparent cause after an afebrile period. There may be an alteration in the pulse-rate without a perceptible temperature change. It does not decrease as it normally should or it may even increase in frequency. Leucocyte count remains high and may go still higher. The patient has no appetite. Sweating is profuse. Prostration becomes marked. The patient occasionally complains of transitory pains in the upper abdomen or chest.

Superficial examination reveals nothing. Exact, careful palpation of the subphrenic region, flank, and chest reveals finally a distinct painful point upon pressure. This may at first seem very unimportant, but it not only remains constant from day to day but increases in size. The localization at repeated examinations remains the same. One is very apt to notice that the impression made by the finger remains in the skin, a skin œdema which is often present. Later the lower lung boundary is found to be immobile. A swelling is not demonstrable either visibly or by palpation. There is dullness over the base of the right lung which is often incorrectly interpreted as the result of the bedridden condition of the patient.

This is the early clinical picture of a subphrenic abscess complicating appendicitis, the single symptoms in themselves seemingly harmless and unimportant, but which considered as a whole constitute a syndrome by means of which it is easy to make a diagnosis.

When there is not the history of a previous appendicitis the diagnosis is naturally more difficult, but even then it can usually be easily made if the case is carefully observed and the above mentioned symptoms and signs made out. Exploratory aspiration is usually unnecessary.

In those few cases in which a diagnosis can not be reached clinically, an exploratory aspiration, as advocated by Beck, must be resorted to. This, however, as with the operation, should not be carried out transpleuraly but should be performed beneath the pleura and diaphragm. The aspirating needle attached to a glass syringe is inserted in the posterior axillary line at the level of the first lumbar spinous process and is directed upward and backward at an angle of less than 45 degrees. Aspiration should be carried out by the insertion of the needle so as to prevent the danger of passing through an abscess and infecting healthy tissues beyond. One should not be satisfied if pus is not obtained by the first attempt, but should try several different directions.

If the symptoms and signs are marked as in the more advanced cases as shown by our Case 2, the diagnosis is easy. But it is essential not to wait until the case presents an advanced clinical picture, as then the patient's resistance is so lowered that the chances of recovery are much less.

REPORT OF CASES

CASE 1. Karl S., age 49, teamster, complained chiefly of pain in abdomen. The family history was negative. The patient had had no diseases in childhood. In 1912 he suffered an attack of hæmatemesis, and was in bed 3 weeks. In 1916 again he had an attack of hæmatemesis but to a lesser degree. Since then he has had no gastric symptoms. He had pneumonia in 1920.

Present illness. October 14, 1922, after the evening meal, patient experienced suddenly a sharp lancinating pain in the right abdomen. No vomiting. A doctor who was called diagnosed gastro-enteritis. On the following day, patient felt no pain when lying quietly but every bodily movement was painful. October 16, the severe sharp pain in the right abdomen again appeared. Patient felt feverish. He was sent into the medical clinic of the Kantonspital for treatment. On the medical service a subacute perforation of a gastric ulcer was suspected and patient was transferred to the surgical service.

Physical examination. Well-developed, well-nourished adult male lying quietly in bed. It can be easily noticed that patient seemingly purposely avoids all movements. The sclera is clear, the pupils regular and react to light and accommodation. The ears and nose are negative. The tongue is moist, covered with a heavy coat. The pharynx is negative. The teeth are in poor condition. The neck is negative. The thorax is narrow and breathing is costal only. There is a percussion note res-

onant throughout the lungs. Breath sounds are vesicular. The spoken voice is normal. No râles are present. Cardiac dullness not enlarged. Heart sounds are clear, no murmurs. Pulse is 108, well filled, regular in force and rhythm. The abdomen is distended with most marked distention in the right lower quadrant. By breathing, the entire abdomen remains stationary. There is a resistance of the entire abdominal musculature upon palpation which is most marked over the ileocæcal region where a marked tenderness is also present. The abdomen is tympanitic throughout, especially in the right lower quadrant. Liver dullness is normal. In the right flank there is a definite dullness which does not move with change of position. Rectal examination shows the sphincter atonic, the ampulla dilated, no protrusion or tenderness in the cul-de-sac of Douglas. Examination of the extremities is negative. The urine is negative for albumin and sugar and there is no sediment. Temperature, 38.5° C. White blood count, 8,750. Diagnosis: (1) acute appendicitis; (2) subacute perforation of a gastric ulcer (?)

October 8. Under conservative treatment (rest in bed, ice bag to abdomen) the temperature has fallen to normal. The extensive resistance has disappeared. There is still a slight resistance in the ileocæcal region.

October 12. Temperature 37.4° C; pulse, 86; white blood count 8,400. Over Poupart's ligament is a slightly tender resistance. Rectal examination shows slight infiltration in the upper right ampulla wall. Continuous warm irrigation by means of the Arzberger tube.

October 17. Temperature normal; pulse, 86; white blood count 6,600. The resistance over Poupart's ligament has almost completely disappeared. The infiltration in the rectum is less marked.

October 25. Examination of the abdomen and rectum reveals practically nothing abnormal. Patient complains of no pain.

November 7. Patient is out of bed, feels fine. Gastro-intestinal X-ray examination shows a slight perigastritis. No ulcer niche nor signs of a previous perforation demonstrable. Stool examination for blood repeatedly negative.

November 9. Afternoon temperature 3.6° C; pulse, 80. Patient says he does not feel well but does not complain of any definite symptom. Examination reveals nothing abnormal.

November 14. Patient complains of pain in the right chest aggravated by breathing. Examination shows pleuritic rub at the base of the right lung posteriorly. No sign of an exudate. Temperature 37.8° C; pulse, 88. Iodine application and electric pad to chest.

November 17. Pleuritic rub still present and in addition signs of a pleural exudate have developed. Because of a right side pleurisy following a probable appendicitis, a subphrenic abscess is suspected.

November 21. Temperature normal. Patient has no pain and feels perfectly well. X-ray examination of chest shows extensive shadow in the lower part of the right lung, the right diaphragm is pulled up. X-ray diagnosis: pathological process above the right diaphragm, a serofibrinous pleurisy. No signs of a subphrenic process.

November 23. Patient out of bed yesterday. Temperature rose in the evening to 38° C; pulse, 84. Patient complains of a sharp pain in the right lower chest. The right-sided dullness has increased and extends up to the level of the eighth dorsal vertebra.

November 24. Gastro-intestinal X-ray examination shows normal stomach and duodenal cap. No sign of a previous ulcer perforation. X-ray diagnosis, from chest fluoroscopy: Serous pleurisy.

November 26. Evening temperature 39.2° C; pulse, 100. Patient perspires freely. No dyspnœa. Right thorax moves less than the left. Dullness over the right base posteriorly extends to the level of the seventh dorsal vertebra. Breath sounds absent, spoken voice diminished. The liver dullness is not increased downward. Over the right thorax a very slight œdema of the skin is present. This is thought to be the result of the iodine applications.

November 27. Slight tenderness upon pressure localized over the right eleventh and twelfth ribs. Clinical diagnosis: subphrenic abscess.

November 28, X-ray examination of the chest. No signs of a subphrenic abscess. To visualize the diaphragm better the roentgenologist attempted to inject air into the suprahepatic space. Needle inserted in the eighth intercostal space in the anterior axillary line under the fluoroscope and 80 cubic centimeters of air injected. After this procedure nothing new could be made out. After the injection patient suddenly went into a state of collapse. Dyspnœa was marked. Perspiration was profuse. The face was pale and cyanotic. The pulse was 100 and thready. After caffeine intramuscularly and digalen intravenously patient recovered in about 15 minutes.

November 29. Operation was decided upon. After preparation of patient, it was decided to try exploratory aspiration. The needle was inserted beneath the twelfth rib in the posterior axillary line and directed upward and backward without entering the pleural or peritoneal cavities. A thick, yellow, slightly foul-smelling pus was obtained.

Operation. Patient lying on the left side with kidney pillow. Ether anæsthesia. Incision was made over and down to the twelfth rib, extending posteriorly to within 4 centimeters of the midline. Subperiosteal resection of the entire twelfth rib. Transverse incision of the musculature was made at the level of the first lumbar spinous process, down to the renal fascia through which the perirenal fat was seen. The upper margin of the incision was elevated by means of broad, blunt retractors. By means of the index finger the renal fascia and the peritoneum, which was continuous with the renal fascia, were bluntly separated from the diaphragm. The peritoneum was œdematous, thickened, and appeared cloudy. Wound tamponaded. Exploratory aspiration of the

pleural cavity *above* the diaphragm yielded a clear, yellow, serous exudate, thus ruling out the presence of a co-existing empyema. Removal of tamponade.

An exploratory aspiration of the subhepatic space was done between the right border of the liver, which could easily be seen and palpated, and the upper pole of the right kidney yielded nothing. Tamponade of the wound in this region. Exploratory aspiration of the suprahepatic space by means of the Clairmont curved needle was fruitless on the uppermost portion of the liver. Aspiration posteriorly in the direction of the right upper posterior space yielded the identical pus as obtained by the preoperative puncture. Peritoneum was further separated from the under surface of the diaphragm in the direction of the abscess. Peritoneum over the abscess was broken through with the finger and about 300 cubic centimeters of pus evacuated. Large rubber drainage tube and iodoform gauze introduced into abscess cavity.

November 30. Temperature has fallen to normal. Wound drains considerably. Patient feels much better. Iodoform gauze removed.

December 5. Rubber tube loosened and slightly withdrawn. Drainage has markedly decreased. Patient feels perfectly well. Dullness over the right base has diminished.

December 9. Drainage has ceased. Drain removed. Patient feels fine.

December 15. Patient is out of bed.

December 20. Wound is almost completely healed, shows no reaction. Dullness over the right base has practically disappeared. No evidence of a pleurisy present.

December 23. Wound entirely healed. Patient has no symptoms. Appendectomy refused.

Case 2. Amalie B., age 18, seamstress, complained chiefly of pain in chest, which was aggravated by breathing, and abdominal pain. The mother and father are living and well. She has no brothers or sisters. No chronic illnesses are revealed in family history. Patient had measles at 4 years; scarlet fever at 5 years; no operations or accidents. In October, 1922, patient had attack of abdominal pain associated with vomiting. After 4 days' diet the attack subsided. Menses began at 14, are painful, always regular and flow moderate.

Present illness. On January 15, 1923, less than an hour after the evening meal, patient suddenly experienced a cramp-like pain in the lower abdomen. Shortly afterward patient became nauseated and vomited. After a bowel movement patient experienced a heavy sensation in lower abdomen, "as if there were not enough room for all the organs." During night patient vomited three times. On January 16 a doctor was called who diagnosed a light attack of appendicitis and ordered hot applications to the abdomen. The pain became localized in the right lower quadrant and more severe. Temperature normal. January 18 patient complained of burning upon urination and also of a dull pain in the right flank which became so severe that it was impossible for patient to lie upon the right side. January 20 patient suddenly experienced in the right chest and high in the flank lancinating pain which was aggravated by breathing. On January 21 for the first time the temperature was above normal, 38.4° C. On January 23 patient was sent into surgical clinic; diagnosis, appendicitis.

Physical examination. Patient is a well-developed, well-nourished, anæmic-looking young girl of typical asthenic habitus. Face is very pale and slightly cyanotic. Temperature, 38.6°; pulse, 120; respiration, 30. Scleræ are clear, pupils equal, regular, and react to light and accommodation. Examination of ears and nose is negative. The teeth are in good condition. Examination of pharynx and tonsils is negative. The tongue is moist, but is covered with a heavy white coat. Examination of neck shows no abnormality. The thorax is well-developed. Thoracic movement on the right side is considerably less than on the left. In left lung the percussion note is resonant. Base of the lung moves well by deep breathing and extends to the level of the eleventh rib posteriorly. Breath sounds vesicular. No râles. In the right lung there is dullness extending from the base upward to the level of the eighth rib posteriorly. Breath sounds absent, spoken voice diminished over this area. The upper level of the dullness is straight posteriorly and laterally. Lung boundary above the dullness is stationary. Breath sounds over the remaining portion of the lung vesicular. No râles. Cardiac dullness extends from the left mamillary line to the right border of the sternum. Impulse in the fifth intercostal space. Heart sounds clear, no murmurs. The abdomen is slightly distended, the right side seemingly more so than the left. On the left side is a slight resistance upon pressure. On the right side, beginning about 5 centimeters from the mid line, is a marked resistance, which is also tender. In this region there is also dullness which extends laterally to within 1 centimeter of the anterosuperior iliac spine, above to the fourth rib, and below to Poupart's ligament. Over this entire area there is an indefinite resistance which is not sharply demarcated from the surrounding tissues. In the right lower abdominal quadrant, and even so in the right flank and especially localized just to the right of the twelfth rib, is a marked tenderness. No œdema is demonstrable. Rectal examination shows an atonic sphincter. There is a diffuse tenderness upon pressure on both the right and left sides. Urine is negative for albumin and sugar; for sediment, negative. Diagnosis: (1) retrocæcal appendicitis, (2) subphrenic abscess, (3) empyema (?)

Immediately upon admission of the patient in the hospital as an emergency, on account of the dyspnœa, cyanosis and pain in the chest, the ward interne's attention was directed to the chest before a complete history was taken. Thinking the case an empyema he immediately explored the chest with the aspirating needle. A thin, bloody, foul-smelling pus was obtained. Microscopic examination showed polymorphonuclear leucocytes and gram-negative

bacilli. It was easy to see from the history that if an empyema existed it was also associated with a subphrenic abscess, so operation was decided upon.

Operation. Patient lying upon the left side with kidney pillow. Ether anæsthesia. Oblique incision, 15 centimeters long, over the twelfth rib, beginning at the outer border of the erector-spini musc. and extending downward and forward in the direction of the anterior superior iliac spine. A subperiosteal resection of the entire twelfth rib was done. Transverse incision was made through the musculature at the level of the first lumbar spinous process down to the renal fascia. Through the long skin incision the muscles lower down were separated in their respective directions and the retroperitoneal and retrocæcal spaces explored bluntly in order to see if there was a possible abscess formation in these regions. Nothing was found. The upper margin of the incision was elevated by means of broad, blunt retractors and the renal fascia and the peritoneum, which was continuous with it, was separated from the under surface of the diaphragm. The peritoneum was thickened and œdematous. Through the peritoneum the right margin of the liver was seen and palpated. Exploratory aspiration of the pleural cavity *above* the diaphragm, with a finger in the suprahepatic space below the diaphragm, to prevent the needle from passing through it, yielded nothing, making it possible to rule out an existing empyema. By exploratory aspiration of the subhepatic space between the right border of the liver and the upper pole of the kidney, a thick, yellow, foul-smelling pus was obtained, thus establishing a diagnosis of a subhepatic abscess. The needle was withdrawn without opening the abscess and this region of the wound tamponed with gauze. Exploratory aspiration of the suprahepatic space by means of the Clairmont curved needle yielded pus which was identical with that obtained by the pre-operative puncture, thus confirming the diagnosis of a suprahepatic abscess. The peritoneum was separated from the under surface of the diaphragm in the direction of the abscess. The abscess was opened by breaking through the peritoneum over it by means of the finger and about 250 cubic centimeters of pus obtained. The abscess cavity was quite large but was well walled off. The subhepatic abscess was opened by breaking through peritoneum with finger and about 200 cubic centimeters of pus evacuated. A large rubber drainage tube and iodoform gauze drain were introduced into each abscess.

January 24. Wound drains considerably. Iodoform gauze removed. Temperature has fallen to normal. Patient feels better.

January 30. Temperature normal. Wound drainage less. Rubber tubes loosened and withdrawn slightly. Patient feels fine.

February 1. Wound has ceased draining. Drains removed. Patient out of bed.

February 10. Wound practically healed.

February 14. Wound entirely healed. Appendectomy revealed chronically diseased appendix.

These two cases represent two phases of the difficulties that one encounters when dealing with a subphrenic abscess, and we have chosen them out of the 17 cases operated on in the clinic according to this method because they are so instructive.

Case 1 emphasizes the importance of careful and repeated clinical observation necessary for the *early* diagnosis of subphrenic abscesses and shows that accurate clinical observation is far more important than the X-ray, which in this case gave repeatedly negative results. Exploratory puncture, although not necessary for the diagnosis, in this case was carried out after the patient was prepared for operation and the abscess found to be located in the typical right upper posterior space.

Case 2, as a more advanced one, presents little difficulty in the making of a diagnosis. However, it is instructive and shows very well one of the advantages of our method over either the transpleural or the transperitoneal methods, in that it was possible to locate and drain both the suprahepatic and infrahepatic abscesses by means of one and the same operative procedure. Had either of the methods mentioned been used in this case, one of the abscesses would have been overlooked.

This is very important practically because in more than 50 per cent (Maydl and Piquands, 53 per cent, Barnard, 60 per cent) of subphrenic abscess cases complicating appendicitis, there are two co-existing abscesses, one above and one below the liver.

TECHNIQUE OF RETROPERITONEAL METHOD

1. Incision over and down to the twelfth rib to within 4 centimeters of the midline posteriorly. Subperiosteal resection of the entire twelfth rib. (Fig. 4.)

2. *Transverse* incision of the musculature below the bed of the resected twelfth rib at the level of the first lumbar spinous process, which should be marked before the operation. In this way the pleura will with certainty be avoided. Careful dissection down to the renal fascia, which is recognized as a smooth, shining, fibrous layer. Through it the renal fat can be seen. (Figure 5 shows the bed of the resected twelfth rib and the transverse incision down to the renal fascia.)

Fig. 4. Exposure of the twelfth rib.

Fig. 5. In the upper part of the wound can be seen the bed of the resected twelfth rib. Below, running in a perpendicular direction, is the incision through the muscle. The lower muscular flap is retracted and the renal fascia can be seen in the right lower corner.

3. If a retrocæcal or retroperitoneal abscess is suspected, the skin incision can be extended downward and forward in the direction of the anterosuperior iliac spine, the muscles separated in their respective directions and the retroperitoneal and retrocæcal regions explored.

4. Blunt separation of the musculature from the renal fascia for a short distance above and below the wound. Broad, dull retractors are placed above which elevate the diaphragm and pleura and protect them from injury. Blunt separation by means of the index finger of the peritoneum above from the under surface of the diaphragm. The peritoneum is found continuous with the renal fascia. This separation is easily accomplished up as far as the dome of the liver, thus enabling one to reach those abscesses located high on the liver surface. If an abscess is present, the peritoneum is markedly œdematous and the separation is even more easily carried out. Anatomical studies have shown that if the separating finger follows the direction of the diaphragmatic fibers which run parallel to the ribs, the separation is still easier.

5. Aspiration of the pleural cavity *above* the diaphragm in those cases in which an empyema is suspected. This is carried out with a finger in the subphrenic space between the separated peritoneum and the diaphragm, so that one can feel the aspirating needle and prevent its passing through the diaphragm.

6. Exploration of the subhepatic space by means of the aspirating needle, the point of election lying between the visible right lower border of the liver and the upper pole of the right kidney (Fig. 6). If pus is obtained, the needle is withdrawn without opening the abscess and the area tamponaded with gauze until after exploration of suprahepatic space.

7. Exploration of the suprahepatic space by means of the curved needle which was advocated by Clairmont for exploration of the upper surface of the liver (Fig. 6). It must be borne in mind that the favorite site of election for a postappendiceal abscess in the subphrenic region is the *right upper posterior space*. For this reason it is of practical importance to direct the needle well posteriorly. If pus is obtained, the obscess is opened by breaking through the peritoneum over it by means of the finger (Figs 7, 8, and 9). If pus has been obtained by the exploration of the subhepatic space, this abscess is likewise drained. Introduction of *large* rubber drain-

Fig. 6. The lower edge of the diaphragm is elevated by means of two sutures. The peritoneum has been separated from the under surface of the diaphragm. The curved perpendicular line on the right is the right liver border, to the right of which lies the renal fascia through which the renal fat can be seen. Beneath the visible liver border is the point of election for the exploration of the subhepatic space. On the left, between the diaphragm and its separated peritoneum, is the point of election for the exploration of the suprahepatic space.

age tubes and iodoform gauze drains into the cavities. We disapprove of irrigation of the abscess cavities because of the danger of breaking through the pyogenic membrane.

8. If an empyema exists (determined by exploratory puncture of the chest, paragraph 5) the pleural cavity may be drained by simple incision of the pleura *above* the diaphragm without the further resection of ribs. Introduction of large rubber drainage tubes.

ADVANTAGES OF RETROPERITONEAL METHOD

1. It is possible to explore and drain both a suprahepatic and an infrahepatic abscess by means of one and the same procedure.

2. There is no danger of contaminating an unaffected pleura or peritoneum. By the transpleural approach, even though one uses the various operative procedures to shut off and protect the free pleural cavity, such as suturing the diaphragm to the pleura, etc., there is always the danger of a resulting empyema. Grueneisen (5) found that in 28 per cent of subphrenic abscesses opened through a normal pleura and in 35 per cent of cases in which there existed sterile fibrinous adhesions, empyema developed in spite of the various operative procedures employed to protect the pleura. Perutz (10) in 67 per cent and Piquands (11) in 78 per cent of cases of subphrenic abscesses found the pleura unaffected. To avoid the pleura when draining a subphrenic abscess is of utmost importance because in 75 per cent of cases (Nather) the pleura is sterile. For practical purposes we can consider the pleural cavity sterile in all cases of abscesses in the subphrenic region, even in those cases in which there is present a pleural exudate or fibrinous adhesions.

Experience shows that an exudate and fibrinous adhesions in the pleural cavity are irritation products of a subphrenic abscess. For this reason the pleural change is of great diagnostic importance. These co-existing pleural complications disappear without any further treatment after the early drainage of the subphrenic abscess, which is the source of the irritation. Empyema develops only in those cases in which drainage is instituted late.

3. By means of our operation it is necessary to resect only the short functionless twelfth rib, producing a wound surrounded entirely by soft parts. As soon as the drainage has ceased and the drains are removed, the walls of the drainage canal fall together and obliterate the cavity.

On the other hand the partial resection of the ribs necessitated by the transpleural method produces an opening, the walls of which are rigid and in reality splinted so that the parietes cannot collapse.

The time taken for the wound to heal and likewise the patient's convalescence is, as is self-evident, much shorter after the retroperitoneal operation even if an empyema coexists.

4. An important surgical advantage is that the abscess is drained in its most dependent portion.

5. By simple extension of the incision downward and forward, it is possible to explore the retroperitoneal, retrocæcal and perinephritic spaces. In combination with the preperitoneal operation (Clairmont-Na-

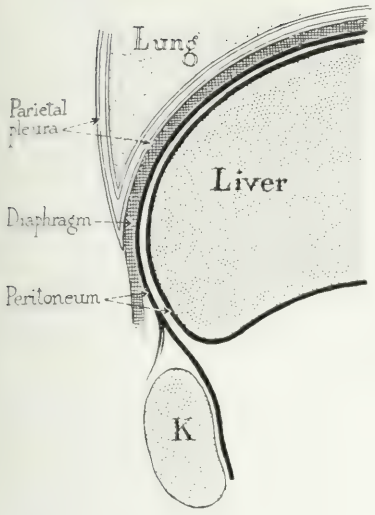

Fig. 7.

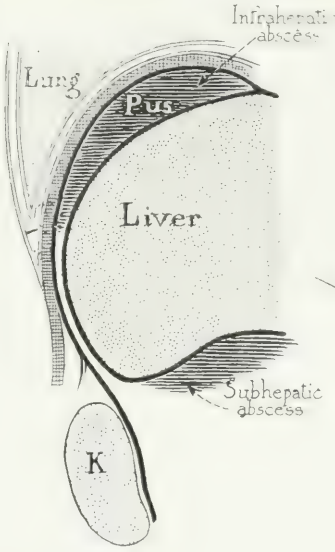

Fig. 8.

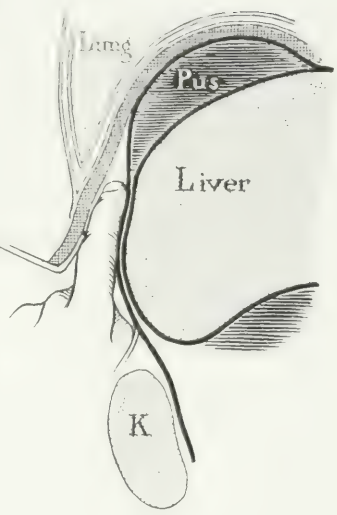

Fig. 9.

Fig. 7. Schematic anteroposterior section showing the normal relations of the right subphrenic region. The shaded portion above is liver and that below is the right kidney. The heavy black line represents the peritoneum.

Fig. 8 Schematic representation of a suprahepatic and intrahepatic abscess (Case 2). The normal potential suprahepatic space is filled with pus. The diaphragm and lower lung border are pushed upward and the pleural angle is partially obliterated. Beneath the liver is the subhepatic abscess.

Fig. 9. Schematic drawing showing the separation of the peritoneum from the under surface of the diaphragm as far as the abscess.

ther, 9) the entire subphrenic region can be drained.

6. There is less shock associated with the retroperitoneal operation than with the transpleural, as only one body cavity is opened.

CONCLUSIONS

1. Careful, exact clinical observation of cases following appendicitis which run an abnormal course leads to an early diagnosis in the larger percentage of cases of complicating subphrenic abscess.

2. In those cases in which clinical observation does not lead to a diagnosis, and it is necessary to resort to exploratory aspiration, it should *not* be carried out transpleurally but retroperitoneally beneath the diaphragm.

3. In cases of subphrenic abscess it is unnecessary and dangerous to use a method of drainage which exposes uninvolved pleura (60 to 70 per cent) or peritoneum to infection.

4. Especially in those cases of secondary abscesses in the subphrenic region complicating appendicitis, it is necessary to use an operation by which an abscess in subhepatic and suprahepatic spaces can be drained at the same time. This combination occurs in more than 50 per cent of subphrenic abscesses complicating appendicitis. The retroperitoneal operation fulfills these requirements.

5. A co-existing empyema can also be drained through the same incision without further resection of ribs.

6. The retroperitoneal operation is surgically and anatomically the operation of choice in the drainage of those subphrenic abscesses complicating appendicitis.

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DEPARTMENT OF TECHNIQUE

THE OPEN OPERATION FOR CONGENITAL DISLOCATION OF THE HIP

By HERBERT P. H. GALLOWAY, M.D., C.M., F.A.C.S., Winnipeg, Manitoba

IT is only within recent years that congenital dislocation of the hip has been rescued from the realm of incurable surgical conditions. The demonstrations given by Lorenz, of Vienna, during his visit to America in 1902 caused a general awakening of interest in this affection, and since that time the manipulative method, either as originally performed by Lorenz or variously modified, has been the accepted treatment. The results of these manipulative procedures have been anything but uniformly satisfactory, the percentage of real cures claimed by most operators being small. Moreover, not a few actual disasters, such as fracture of the femur, separation of the capital epiphysis of the femur, fracture of the pelvis, injury to peripheral nerves and gangrene of the extremity, have resulted from unwise attempts to effect reduction in patients who were too old, or whose tissues were so unyielding that extreme and unjustifiable force was used. However, inasmuch as some patients were actually cured and many others functionally improved by the Lorenz method and its various modifications, most surgeons have preferred to treat their patients by manipulation, for few have had any extended experience with the open operation.

As far as I am aware, the first surgeon on this continent who strongly opposed the manipulative method and advocated open reduction was the late Harry M. Sherman, of San Francisco, who in 1904 presented a remarkable paper at the meeting of the American Orthopedic Association in Atlantic City. Dr. Sherman's paper must be read to be appreciated. Discouraged with the generally unsatisfactory results of the manipulative method he abandoned it in 1898, and with one exception employed the cutting operation in all of his subsequent cases up to the time his paper was presented 6 years later.

The following quotation from Sherman's paper affords food for thought:

"As regards the manipulative method, I am sure that Lorenz told the whole truth when he stated that the obstacle to reduction was the narrowed part of the capsule at the posterior and superior, or superior part of the acetabular rim. If the opening at this narrowed part is big enough to permit the head to pass, reduction can be accomplished by manipulation, and may be maintained if the acetabulum is deep enough. I have in two instances done this, I know. But in the twenty-eight hips in which I have done arthrotomy, and in which I have explored the narrow part of the capsule by my finger, and so know its size and the strength of its walls, there has been but one case in which the passage of the head would have been possible. I am not too dogmatic when I say that no possible force could have put the femoral head through the narrow part of the capsule in any of the other cases."

Up to the time that Sherman's paper appeared, my own experience with manipulative methods had been about the average; only a very few actual cures and a fair percentage of cases functionally improved. The most disturbing degree of uncertainty attended the treatment of every case; one always had the feeling that the final outcome was a gamble. Dr. Sherman's paper was so convincing that I immediately began to try the open operation in selected cases, and finally abandoned the manipulative method. In June, 1920, I read a paper at the annual meeting of the American Orthopedic Association strongly advocating the open operation and presenting an impartial review of my results. Since that time the operation has been further developed and improved, until now the results *in young children* are so uniformly satisfactory that one no longer approaches these cases with a feeling of dread or uncertainty, but with confidence that the treatment is simple, safe and practically certain to result satisfactorily.

It must not be forgotten that each worker in the field of open operations for this condition is more or less of a pioneer, for, because of the almost universal employment of manipulative methods the open operation has been practically without either teachers or students. The writer never had the advantage of seeing Dr. Sherman operate, but for a long time followed, as closely as possible, his published description. Gradually, however, certain modifications were made, and, since my

Fig. 1. The Sprengel incision.

Fig. 2. Interval between tensor fasciæ femoris and rectus.

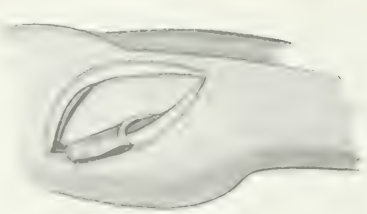

Fig. 3. Muscles divided along crest of ilium and retracted. Rounded outline of head visible through capsule.

former paper appeared, some details have been introduced which have proved highly advantageous.

Let it be clearly understood, however, that my claim that the open operation is simple, safe, and reliable, applies particularly to children under 3 years of age who have never been subjected to treatment by manipulation or otherwise.

DESCRIPTION OF THE OPERATION

In my former paper I described two paths of approach to the hip joint, the anterior and the posterior. I now employ, exclusively, the exposure first described by Sprengel, and more recently popularized by Smith-Peterson, who appears to have been unaware of Sprengel's prior description.

Patient is placed on the table with a sandbag under the trunk, so arranged as to raise the pelvis on the side to be operated on. Beginning at a point just below the crest of the ilium and from 2 to 3 inches behind the anterior superior spinous process, an incision is carried forward just below the crest to a point immediately below the tip of the anterior superior spinous process. The incision is then carried down about 3 inches in the long axis of the thigh. The first incision should include merely the skin and superficial fascia. Skin towels, backed with waterproof material, are then clamped on the edges of the wound. With a fresh knife the interval between the rectus and tensor fasciæ femoris is now located and opened up; then the incision along the crest of the ilium is deepened to the bone. In young children, it is necessary to do this with some care, because the bone is so thin and soft that it can easily be cut through. With a periosteal elevator, the muscles are easily stripped from the ilium and the capsule of the hip joint fully exposed. By rotating the limb inward and outward, the head is now readily felt, usually a little below the level of the anterior superior spinous process.

While the limb is held fully rotated inward a longitudinal incision is made through the capsule, this incision being an inch, or slightly more, in length. The capsule is always surprisingly thick, and this incision should be carried down through it with great care so as not to wound the cartilage of the head. The object of rotating the limb inward, before commencing the incision into the capsule, is that this effectually guards against any possible wounding of the ligamentum teres. The moment the joint has been opened, some synovial fluid escapes and the glistening head can be seen.

The longitudinal incision through the capsule is now converted into a crucial incision by incising the anterior and posterior margins of the longitudinal cut to the extent of from one-quarter to three-quarters of an inch.

If the limb be now rotated outward the ligamentum teres, which is nearly always surprisingly large, comes into view, and, by following it in toward the pelvis with the finger, the acetabulum is located.

In practically every instance, deep in toward the joint, a constriction is felt in the capsule; to the finger it gives the sensation of a sharp crescentric fold, the free concave margin of which looks upward toward the roof of the acetabulum. This is divided freely in a downward direction, using for this purpose a hernia knife which is introduced flat-wise along the left index finger, cutting edge turned toward the constriction after it has been introduced to sufficient depth.

In some instances the head may, without any difficulty, be manœuvred into place by abducting the limb and rotating it inward, but usually it will be found of advantage to use a hip skid. The instrument I use is one which has been slightly modified from a model kindly furnished me by Dr. W. R. MacAusland. This instrument is introduced into the acetabulum and holds the soft tissues out of the way while acting as a kind of "shoe horn" along which the head is slid deeply into the acetabulum.

I always redislocate the head once or twice so as to test the position of greatest stability. It will

usually be found that abduction of from 45 to 60 degrees and pronounced inward rotation will maintain a perfectly stable reduction.

With a continuous suture of plain catgut, the deep tissues are quickly brought together, particular care being used to bring the muscles which were divided along the crest of the ilium into place again. Usually no attempt is made to close the opening in the capsule; in fact, the moment the head is reduced the incision in the capsule falls together so perfectly that often it cannot be seen. The skin incision is closed with three or four silkworm-gut sutures and a continuous catgut suture.

It is of course important that while the tissues are being stitched up and the plaster applied the position of stable reduction shall be maintained by a reliable assistant. In many cases, however, the reduction is so stable that the limb simply lies in the proper position during the closure of the wound without any special attention being paid to it. A plaster-of-Paris spica is applied from the nipples to just above the ankle, the knee being slightly bent so as to maintain the position of internal rotation.

An X-ray picture is taken through the plaster 2 or 3 days later. About 3 weeks after the operation, the plaster is removed and the stitches taken out. The plaster is then reapplied without changing the position of the limb, except that the knee is bent to a less degree. From that time on the child is encouraged to bear weight on the limb. In from 6 to 8 weeks the plaster is again removed and reapplied, this time the degree of abduction and inward rotation being slightly lessened.

One or two other changes of the plaster are made, at intervals of about 6 weeks, and each time the limb is brought nearer to the normal position. Within 5 or 6 months all dressings are discarded and the child allowed to go about freely.

Quite recently interest in the treatment of congenital dislocation by manipulation has been renewed by the remarkable claims put forward by Denuce. His method differs materially in important particulars from that of Lorenz, and it is claimed that 98 per cent of his cases are cured. On this continent Dr. Z. B. Adams, of Boston, is Denuce's leading disciple, and having had the privilege of witnessing his demonstration of the Denuce method I can testify that it is very convincing.

What of the open operation, if future experience demonstrates that the results claimed by Denuce can be regularly secured by other surgeons? Other things being equal it is granted that if a congenital dislocation can be reduced in a few minutes by a simple and easy manipulative procedure which requires no elaborate surgical technique, it is preferable to an open operation which demands perfect asepsis, and which should never be undertaken except by a highly trained surgeon.

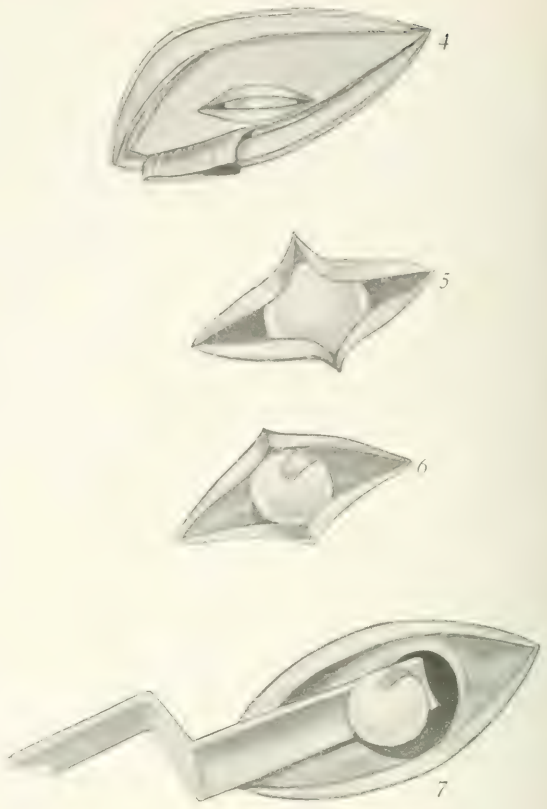

Fig. 4. Incision through capsule exposing head.
Fig. 5. Longitudinal incision through capsule converted into crucial incision.
Fig. 6. Ligamentum teres brought into view by rotating limb outward.
Fig. 7. Hip skid introduced into acetabulum acting as a "shoe horn."

But are other things equal? Denuce does not allow his patient to begin walking until about 1 year after the hip has been reduced, and he appears to regard as essential a course of rather elaborate after-treatment extending over many months, and even as long as $2\frac{1}{2}$ years. After the open operation in children under 3 years, walking in the plaster is encouraged within a few weeks, and the plaster is abandoned and no further treatment considered necessary after 5 or 6 months. I believe that treatment could be dispensed with much earlier in most cases, but have not felt justified in taking chances to discover

what is the minumum safe period of after-treatment. The advantage of a method which can be concluded in 6 months, or less, over one requiring several times as long, is too obvious to require comment; especially is this so when one is dealing with private patients who have come a long distance, who cannot remain away from home indefinitely, and with whom expense may be an important consideration.

The fact that Denuce's method requires such prolonged after-treatment is not only an objection to it, but in my opinion it affords additional evidence in support of my belief that cure by any manipulative method can be brought about only by the gradual absorption through pressure of capsular tissue, which more or less completely blocks the entrance to the acetabulum and effectually prevents the cartilage of the head from coming into contact with the cartilage of the acetabulum at the time the manipulative reduction is effected. In other words, it is my belief that reduction by manipulation is practically always incomplete at first, and becomes stable only after the capsular tissue pushed before the head has become absorbed.

In this connection the reader is once more referred to Dr. Sherman's statement that in twenty-eight hips in which he had explored the narrow part of the capsule and so knew its size and the strength of its walls, there was but one case in which the passage of the head would have been possible, and that no possible force could have put the femoral head through the narrow part of the capsule in any of the other twenty-seven cases.

My own experience fully confirms Dr. Sherman's claims. In doing the open operation I have frequently invited my assistants to feel the constricted opening into the acetabulum before and after dividing it with the knife. As soon as the constriction has been divided it is plain that the real obstacle to reduction has been removed and the head can then be buried deeply and securely in the cavity which nature provided for it. It is an interesting fact, which I have often observed, that when this obstacle has been removed the acetabulum will often be found to be much more capacious than the X-ray picture would lead one to expect.

It is granted, as a serious objection to the open operation, that it should never be undertaken except by surgeons who have complete confidence in their operative skill, and who can operate under conditions such that failure of any link in the chain of asepsis is practically impossible. The same objection, however, applies to many other surgical procedures and should not deter a surgeon who has learned to have confidence in himself and in his surgical environment.

The ideal time for operating is between 2 and 3 years. In a general way the operation becomes more difficult and uncertain as the age advances, although exceptionally, in children from 5 to 12 years of age, no special difficulty is encountered. In children of 3 years, or younger, who have not been subjected to manipulative or other treatment, the ligamentum teres is usually intact and is an important guide in locating the acetabulum. In older children, and in those who have had a previous unsuccessful manipulative reduction, the ligamentum teres is usually absent, or is found detached from the head and curled up in the acetabulum.

The treatment of congenital dislocation in adults is an entirely different problem from that encountered in young children, and its discussion does not come within the scope of this paper.

The illustrations showing various steps in the open operation are diagramatic rather than anatomically exact.

RECONSTRUCTION OF THE URETHRA AFTER COMPLETE LOSS, COMPLICATING AN EXTENSIVE VESICOVAGINAL FISTULA

The Operative Technique Employed with Success[1]

By GEORGE GRAY WARD, M.D., F.A.C.S., New York
From the Clinic of the Woman's Hospital

WHILE the difficulties to be overcome in the curing of extensive vesicovaginal fistulæ are often appalling, yet it is surprising what patient persistence on the part of both patient and surgeon will accomplish in closing large defects in the bladder base. However, where there is added to these difficulties the complication of a destruction of the urethra and consequent loss of control, we have, indeed, a problem which will try our skill and ingenuity to the utmost. No two cases are exactly alike and the technique must frequently be improvised to meet the particular conditions present. Therefore, carefully executed illustrations, made during the operation, of the steps employed where success has been attained, must be of help to others in solving like problems. This, then, is my reason for reporting this case.

Mrs. M. I., age 23, married 2 years, first came under my care at the Woman's Hospital in October, 1920, complaining of complete urinary incontinence dating from her labor in December, 1919, when she had a full term baby delivered by craniotomy. During delivery the cervix was badly torn and a traumatic vesicovaginal fistula was produced. The patient entered the Lying-In Hospital in January, 1920, for the repair of the fistula, and I am indebted to Dr. Kosmak for the details of the history while in that institution as follows: "Exploration under anæsthesia showed the fistula about one-half inch in diameter including the posterior portion of the urethra and involving the trigone. The vault of the vagina showed no opening communicating with the uterus and no trace of the cervix.

"The vaginal vault was very rigid, and full of scar tissue, and the bladder firmly anchored. It was impossible to separate the bladder wall from the uterus because of the inability to locate any cervical opening. Wide lateral incisions in the lower portion of the vagina failed to give sufficient room to expose the operative field thoroughly. An exploratory laparotomy was, therefore, done and disclosed a small, well-involuted uterus with normal tubes and ovaries. The lower segment of the uterus and the bladder were firmly embedded in a mass of scar tissue, so that the uterus could not be pulled upward. An incision was made transversely in the fundus and a sound carefully intro-

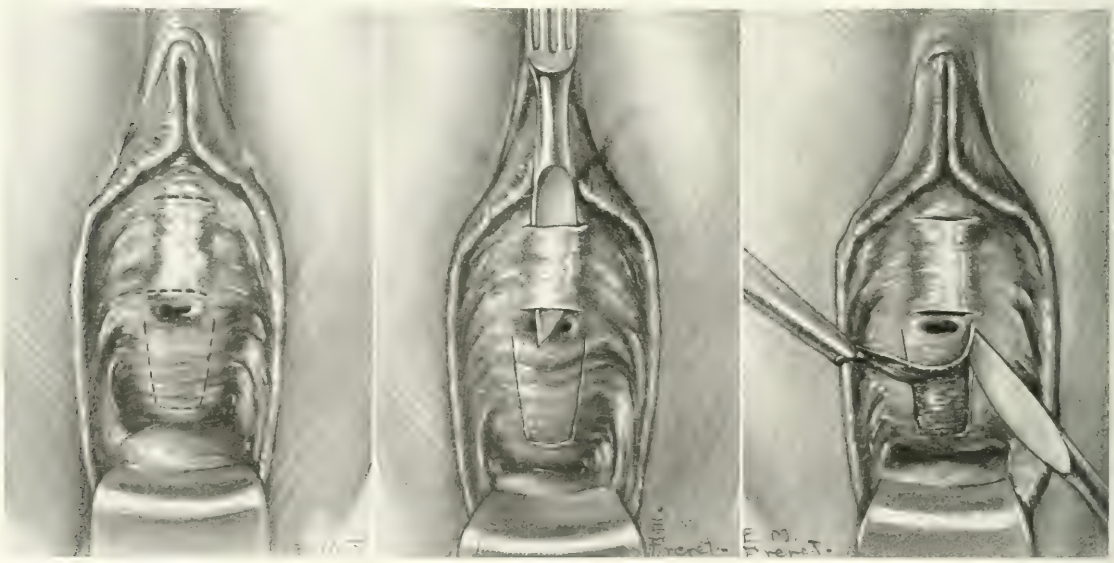

Fig. 1. Fig. 2. Fig. 3.

Fig. 1. Reconstruction of the urethra. The condition of the parts shown after the operations for closure of extensive vesicovaginal fistula which involved loss of the anterior vaginal wall and trigone of the bladder the size of a twenty-five cent piece. The opening shown is at the site of the internal meatus. The white area above it represents the superior wall of the urethra, the posterior and lateral walls having been destroyed. Outline of the flap and incision.

Fig. 2. Tunnel made with a scalpel in the vestibule behind the site of the urethra.

Fig. 3. Dissecting up the flap for the new urethra which is left attached to the opening in the bladder.

[1]Read before the American Gynecological Society, Hot Springs, Virginia, May 21–23, 1923.

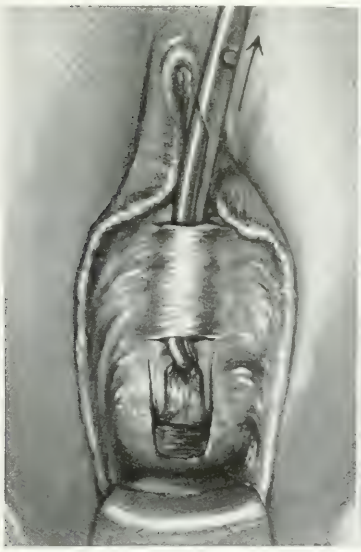

Fig. 4.

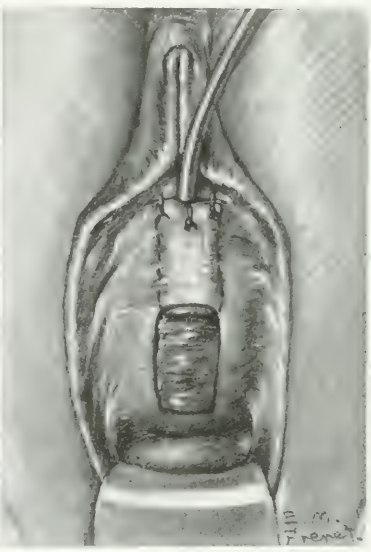

Fig. 5.

Fig. 4. Drawing the flap through the tunnel to form the new urethra.
Fig. 5. The flap sutured to the upper opening of the tunnel and a small catheter inserted into the bladder to maintain the patency of the new urethra.

Fig. 6. The denuded area on the anterior vaginal wall is extremely thin as the flap was procured from the scar tissue of the previous operation for closure of the defect; therefore it requires reinforcement. The right labium minus is put on the stretch and an incision made throughout its length on its inner surface opening its folds.

duced in an attempt to find the outlet. This was accomplished with moderate pressure and a soft rubber catheter pushed through this artificial opening in the vaginal vault, and left *in situ*. The fundus uteri was closed with interrupted gut sutures, and no further attempt to close the

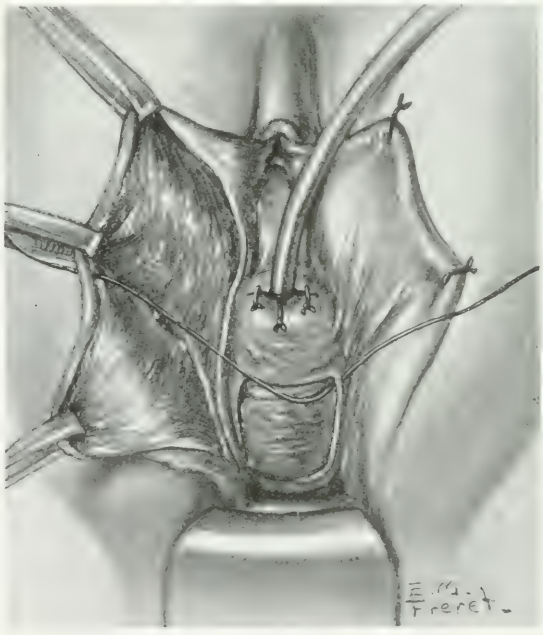

Fig. 7. The dissection unfolding the labium minus complete, and the first suture passed.

Fig. 8. Completing the suturing of this attached flap to the defect at the bladder base.

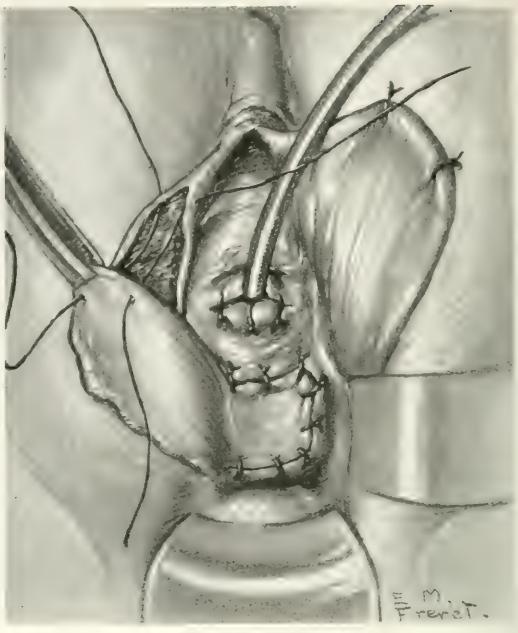

Fig. 9. The denuded area of the vagina and the bladder completely closed with the attached flap and sutures passed to close the upper angle of the incision.

fistula was made. On May, 1920, on re-examination, the uterus was found anteverted, not freely movable, apparently slightly enlarged. The patient had had a menstrual flow lasting 24 hours 2 weeks previously. The fistula seemed reduced in size."

Evidently the stenosis of the uterine canal had been relieved by this operation as the patient gave us a history of regular menstruation without discomfort since that time. Unfortunately, our difficulties were increased on account of the patient being very short and very obese, weighing over 200 pounds, but this was partially compensated for by her extraordinary happy disposition and common sense, and throughout she gave us every co-operation which, in no small measure, contributed to the success of our efforts.

Our examination showed a vesicovaginal fistula at the site of the trigone and involving the urethra, nearly as large as a 25 cent piece. There was dense scar tissue in the vaginal vault and on both sides of the pubic arch, making the base of the bladder and the anterior vagina and cervix firmly fixed. The posterior vagina also was full of scar tissue, the result of the previous operation.

On October 26, 1920, I operated as follows: A typical Schuchardt incision was made extending from the vault of the vagina to the coccyx. This gave an access without which it would scarcely have been possible to reach the parts involved (1). Incisions were then made through the scar tissue of the vaginal vault to the subpubic arch, and above, and on either side of the site of the urethra, thus loosening the tissues in order to allow approximation of the margins of

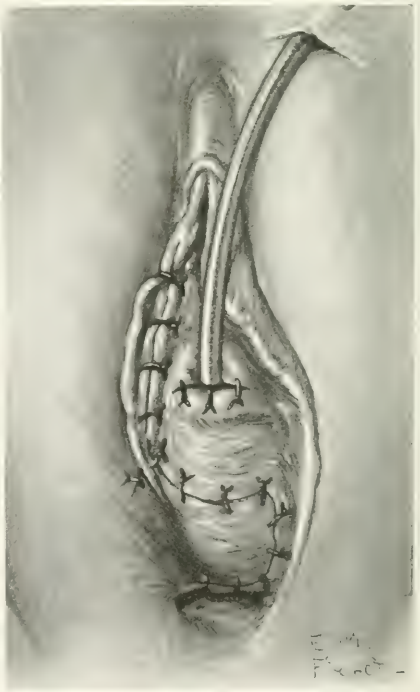

Fig. 10. The completed operation.

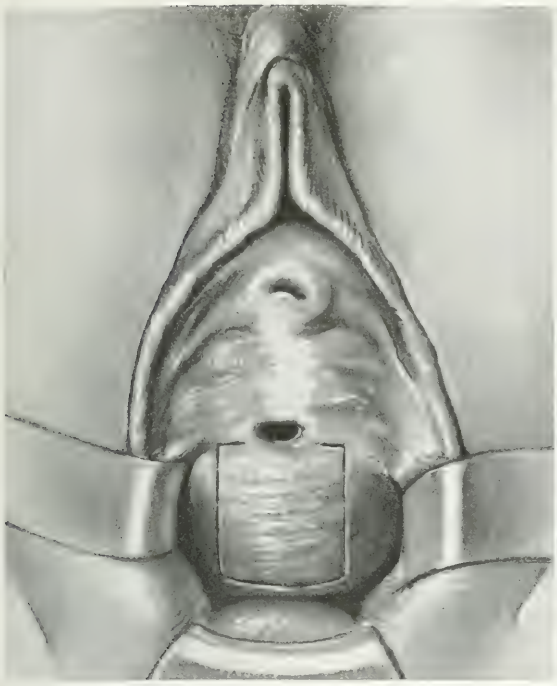

Fig. 11 (at left). Outline of flap to be at the same location as in the previous operation but wider.[1]

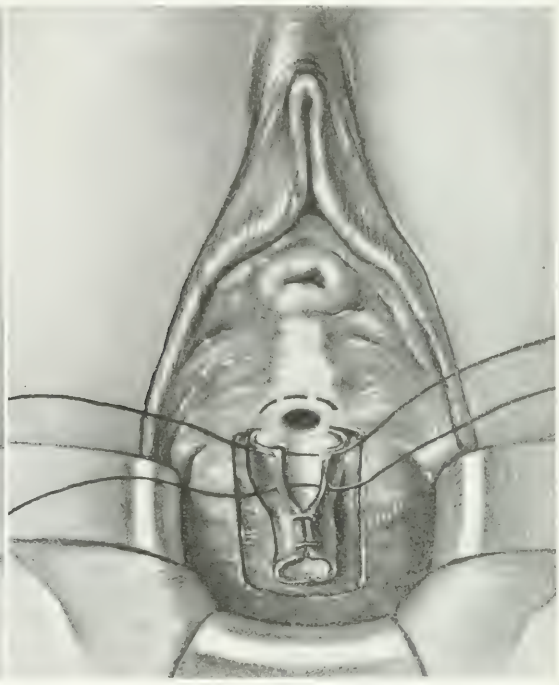

Fig. 12. Lateral edges of the flap united by sutures.

the fistula without tension. The vaginal edges of the fistula were dissected free from the bladder edges for approximately one-quarter to one-half an inch and the bladder opening united with interrupted No. 1 tanned gut sutures. Silkworm-gut sutures closed the vaginal edges, and the incisions in the scar tissue were closed in the reverse direction with catgut. On the left side of the vaginal vault, it was impossible to close the incision in the scar tissue because of the tension, and it was left to granulate. A self-retaining catheter was inserted, and the Schuchardt incision was closed. No attempt was made to construct a urethra.

On November 23, 1920, the patient was again anæsthetized and carefully examined. It was found that the fistula was now reduced to a diameter of about one-quarter inch and was just posterior to the site of the internal meatus. The margins of this opening were denuded and interrupted sutures were passed to narrow the orifice in the hope of increasing the vesical control. The result of the operation was partially satisfactory, as the patient could remain dry while in the recumbent posture until the bladder became sufficiently filled to reach the level of the orifice at the neck of the bladder. By getting up to empty her bladder two or three times at night she was able to keep dry and she felt that a great gain over her previous distressing state had been accomplished. As soon as she stood erect, however, the leakage began to be troublesome. She was anxious for a further attempt to give her better control and she was re-admitted to the hospital and the next operation was done on January 9, 1922, when an effort was made to construct a urethra.

The inferior urethral wall was entirely absent, although the superior wall with its mucosa was present with fragmentary margins along each lateral wall. There was an entire absence of urethra or mucosa around the neck of the bladder at the site of the internal meatus. A scalpel was used to undermine the edges of each lateral wall of the superior urethra that remained, and the loosened flaps thus obtained were made to encircle a small rubber catheter which was passed into the opening in the bladder, and the edges were united with tanned gut sutures. The cut edges of the mucous membrane of the vestibule and anterior vaginal wall were then brought together over the new urethra with silkworm-gut sutures. The result of this operation was a complete failure as the tissues sloughed away, and the patient was discharged in the same condition as on her second admission.

She was admitted to the hospital for the third time on October 25, 1922, and I operated on November 8, 1922, and the result was most satisfactory.

In the first attempt I was guided by the method successfully employed by C. P. Noble (2), and in studying the problem at the second operation I determined to try the technique of Kelly, of making a tunnel under the vestibule and drawing through it a long flap, dissected from the anterior vaginal wall with its end left attached to the vesical opening (3). I had grave doubts as to my

[1] Figures 11 to 14 illustrate technique suggested by Dr. Lillian Farrar

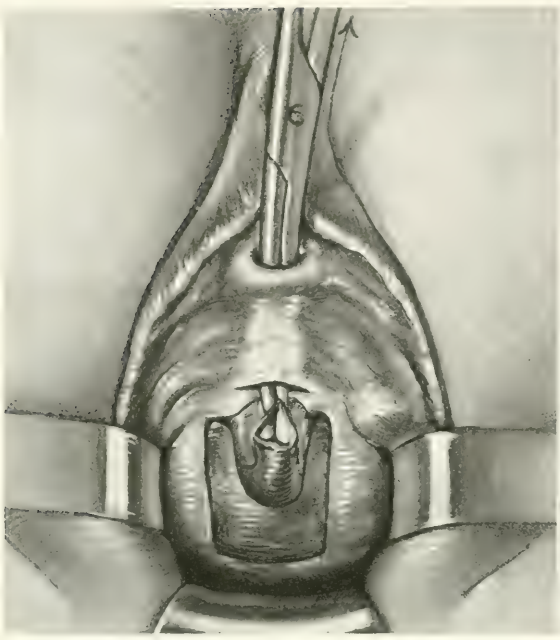

Fig. 13 (at left). Flap pulled through tunnel.

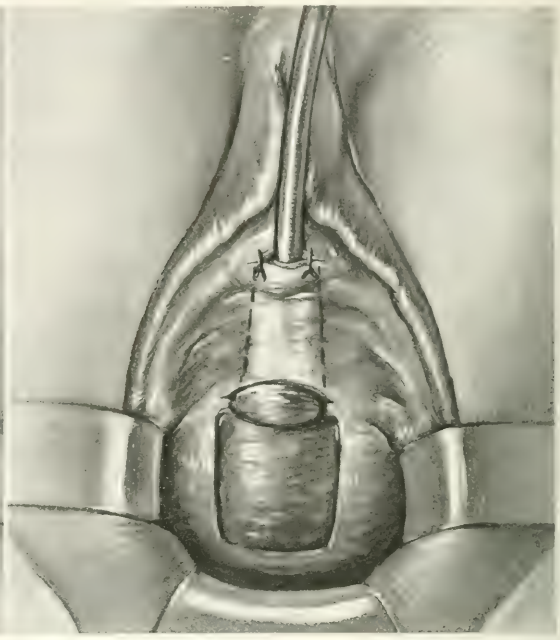

Fig. 14. Tube sutured to the upper opening of tunnel.

being able to employ this ingenious procedure, because the anterior vaginal tissues from which I should have to obtain this flap were so thin, and were made up largely of scar tissue as a result of my original operation for the closure of the extensive defect in the trigone of the bladder. My fears were justified, as after I had succeeded in dissecting up a flap sufficient for my purpose, I had exposed the bladder wall underneath which was so extremely thin that it was not possible to leave it to granulate, and neither was it possible to approximate the lateral edges of the vaginal wound as the denuded surface was too wide.

The suggestion of Noble to use the labium minus as an attached flap in this region seemed worth trying and I, therefore, resolved to employ this tissue to cover this denuded and weakened area at the base of the bladder. After first making a tunnel with a scalpel behind the original site of the urethra and drawing the vaginal flap through it and suturing it in place, I accordingly incised the inner surface of the right labium minus at its attachment to the vestibule from the region of the clitoris to its base and then unfolded it by careful dissection. This gave me an ample flap attached by a broad base which was easily brought in place over the denuded area of the vaginal wall and was sutured in position with silkworm gut. The upper angle of the incision where the labia was detached was then sutured together. A very small soft rubber catheter (not a mushroom) was inserted in the new urethra and fastened with a suture.

The tissues healed without difficulty and the result was most satisfactory as the patient is dry in both the recumbent and erect posture and she can urinate without difficulty. We were particularly fortunate in establishing a good control in this case, probably due to some reenforcing sutures placed at the neck of the bladder at its junction with the new urethra.

Complete loss of the urethra is of comparative rare occurrence and there are not many cases in the literature. Noble states that he has heard Emmet say that in his large experience while he had succeeded in six or seven cases in restoring the urethra all of them were unsatisfactory and he would abandon further attempts. In both Noble's and Kelly's cases, pressure with a tampon or special pessary was necessary to insure control. Baker Brown seems to have had unusual success in three cases he has reported (4).

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CANCER OF THE UPPER JAW, ITS SURGICAL TREATMENT

By W. S. SCHLEY, M.D., F.A.C.S., New York

THE operability of any given case of malignant disease depends much upon the operator's experience, skill, and interest in the particular region in which the malignancy is located. It has been the experience of every surgeon to have had cases present themselves that had been pronounced inoperable yet when operated upon later were either cured or had long immunity from recurrence. Perhaps there is no region of the human body where this has been more true than in the superior maxillary region, even in the presence of extensive carcinomatous or sarcomatous disease.

The removal of the upper jaw for malignancy is still an operation of comparative rarity, yet there are few if any regions where extensive cancerous affection can be so satisfactorily dealt with and where the results of careful and thorough operative work are so remarkably good. Its apparently formidable character, and, finally, the seemingly inevitable possibility of disfigurement, in conjunction with the fact that it is questionable whether cure can be secured, are apt to halt both surgeon and patient. Some of these cases which were refused operation by men of surgical experience have, after subsequent operation, shown cures of 9, 7, and 5 years, and are still well.[1]

In the upper jaw, as with the lower, carcinoma is more frequent than sarcoma. Cancer of the upper jaw, and particularly that affecting the maxillary antrum, remains a local disease until quite late in its development. It does not tend to metastasize to the degree of cancer elsewhere. Extention to the cervical lymphatics occurs only at a late stage in carcinoma and not at all or only at a very advanced stage in sarcoma. The pressence of infected lymph nodes is not in itself a contra-indication to operation. Such cases, after a thorough block dissection of the neck, will generally remain free of any further neck extension even with a renewal of the disease toward the orbit and nares. I have seen the neck remain clear even with extension of the disease into the pterygoid region. The creation of a distinct lymphatic

[1] The operative results are not as good as they should be, and this is largely due to two factors: First, to the late stage at which so many present themselves, often due to wrong early diagnosis, and, second, to the fact that the primary operation was incomplete.

Fig. 1. Line of incision for radical or partial removal of maxilla.

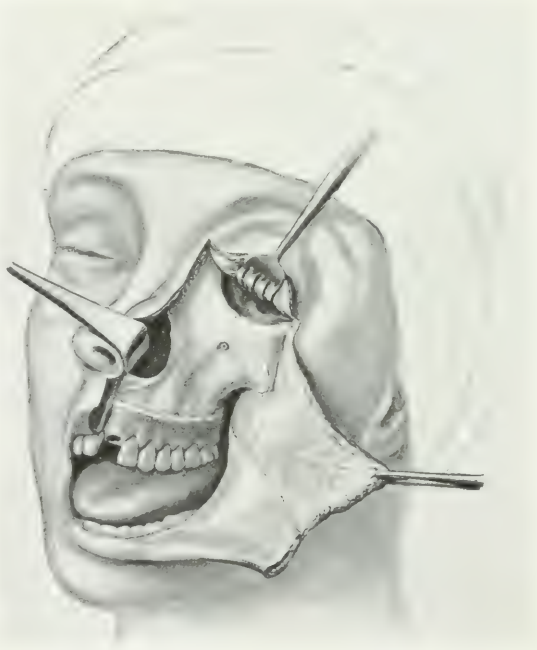


Fig. 2. Wide exposure of the bone before separation of its attachments. This incision may be greater or less, depending upon the requirements of the case.

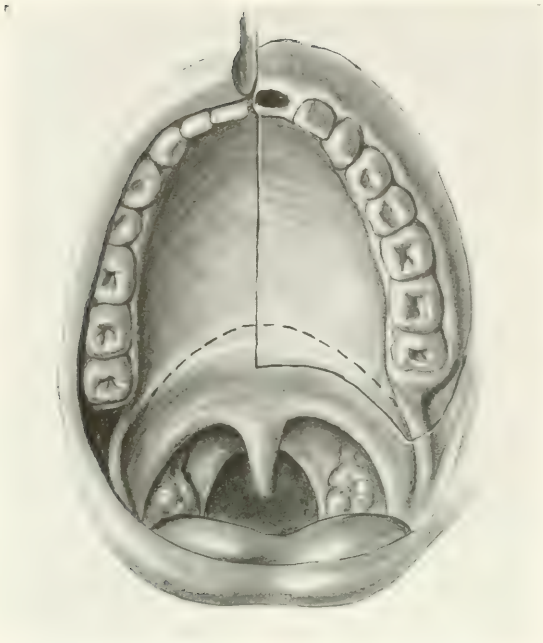


Fig. 3. Line of incision of hard palate, best made slightly to one side of the median line and soft palate then divided.

block is a matter of the greatest importance in all operations for malignant disease and erpecially in that affecting the mouth and jaws. The great majority of recurrences are local, where they are more amenable to further surgery or radiation or both, but the primary operation must be thorough

Fig. 5. The thin bony walls which separate the various sinus spaces offer remarkable resistance until late in neoplastic disease.

Fig. 4. The ethmoid cells are in close proximity and are not infrequently invaded with disease originating in the nasal mucosa or about the antral opening.

and well beyond the appreciable limits of disease, as these recurrences may be infinitely more difficult and at times impossible to deal with. The great danger is that there may follow the deep extension into the pterygoid muscles and region. As elsewhere our results in the main are directly proportionate to the care exercised upon first attack and to the extent of the field of operation. It would seem that there has been a tendency to limit the extent of operation for cosmetic and other reasons, but the greatest care should be exercised and the operation suited to the case. It is wiser not to be too conservative.

The operability is not always easy to determine; it is not invariably the extent of the disease that determines this. The character of the growth, apparent malignancy, chief situation and direction, the amount of extension and the condition of the patient should all be weighed. If the growth is confined to the maxilla alone or to the maxilla and the nares the necessary work is greatly simplified. With surface or deep extension toward the soft palate, faucial pillar, or involvement of the orbit or skin of the face, the difficulties are much greater but not by any means always insurmountable. A case reported herewith was of that type and is now alive and well 9 years after the last of two rather prompt local recurrences deep in the faucial pillar. When the disease has invaded the pterygoid muscles, and the sphenomaxillary space, it may be considered surgically hopeless.

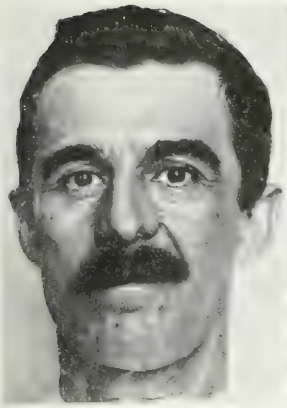


Fig. 6.

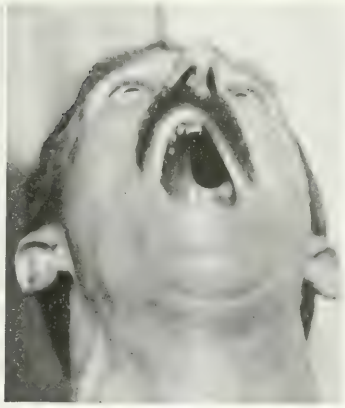


Fig. 7.

Fig. 7.

Fig. 6. W. G. Six and one-half years after operation upon the left side.

Fig. 7. Appearance of roof of mouth and prosthetic appliance worn by patient with comfort.

The preparation of the patient is important. Oral prophylaxis, especially with alveolar or palatal growths, must be thorough. The general condition of the patient and, where advisable, the hæmoglobin should be improved so far as possible during the time it is considered wise to delay. A careful skin cleansing insures rapid and accurate primary union of the skin and muscle flap, which is rarely involved even with a pronounced bulging from a growth within. Preliminary ligation or compression of the external carotid at or above the level of the superior thyroid is valuable in reducing blood loss, which is then reduced to a minimum. In a very radical excision of the upper jaw, I have seen blood loss as low as 4 ounces, by a very careful estimate.

Within my own experience and in my observation of the work of others in this country, patients have stood the operative work well and are out of bed upon the seventh day. The literature upon this subject is not great. As nearly as can be ascertained, the operative mortality during the last 20 years in the hands of all operators has been 12 to 15 per cent. Reports from the European clinics place it at from 20 to 30 per cent. This greater mortality abroad seems to have been due largely to a more extensive operation than is used in this country as well as to the inclusion of a wider operability. I believe that it is possible to employ all the continental thoroughness and still obtain the best American figure heretofore recorded, namely about 9 per cent, and better this by careful preparation. The earlier mortality was largely due to two factors, sepsis and hæmorrhage. Postoperative pneumonia contributed to many fatalities, as high as 72 per cent of the deaths in one record. Shock and exhaustion were frequently recorded, undoubtedly from excessive blood loss. We have controlled sepsis and hæmorrhage very completely, and pneumonia should be no more frequent than after any operation. We do not interfere with the muscles of deglutition as with excision of the lower jaw and have not that added source of danger. With good preparation and technique, the operative mortality is not large and there is but little disfiguring, as the photographs of average cases without prosthetic apparatus show. In carcinoma of the upper jaw the glands should be dissected whether palpable or not. This can be done at a prior sitting or at the time of the jaw excision, depending upon the condition of the patient. In sarcoma, unless glands are palpable, it is rarely necessary to dissect the neck, although it is a safe precaution. A very small percentage of cases will show cervical glands invaded upon the opposite side from that of the primary growth, and dissection of both sides of the neck has been advocated in all cases. In tumors of either upper or lower jaw, it is well to consider the possibility of hypernephroma, Paget's disease, or malignancy elsewhere.

For the operative work, moderate head elevation is more desirable. Patients are given a preliminary dose of morphine and atropine to compensate for the lighter anæsthesia. During the operation anæsthesia is induced in the usual way and is continued by means of nasal tubes passed to the pharynx. The atropine has the advantage of diminishing tracheal mucus. The pharynx may be lightly packed with broad gauze about the tubes so that nothing enters the larynx and trachea. The exposure of the operative field is best accomplished through the Ferguson incision, through the midline of the lip about the ala of nose toward the inner canthus of eye and then outward below the orbital margin, whether we are to do a partial or more complete excision. This incision gives excellent exposure and command and, with a care-

Fig. 8 (at left). R. B. Four and one-half years after operation on left side.

Fig. 9. R. B. Partial view of hard palate without prosthesis.

Fig. 10 (at left). M. B. One year after operation upon the right side.

Fig. 11. M. B. Partial view of hard palate with plate removed.

ful reparative suture, as the facial muscles are entirely unimpaired, a very slight defect results. The orbital plate as support for the eye should be left if possible, but with extension of the disease to the inner canthus of the eye the orbit must be cleaned out. The posterior wall with the pterygoid attachments can nearly always be left. With a growth completely limited to the antrum or to the antrum and contiguous portion of the nasal fossa, it is possible to remove only the anterior wall, or the anterior and nasal sides, and complete our excision by knife, spoon, or cautery, leaving the hard palate, which is of great advantage. This is especially permissible in sarcoma of the so-called giant-celled type where excision with the inlay of a good radium dosage is sufficient. With extensive squamous-celled carcinoma affecting the bone we are compelled to do radical work, and the greater the care exercised and the more thorough the excision, the greater will be our success.

Clean, sharp division of the hard and soft palatal structures well beyond the area of involvement produces the minimum trauma and allows a quicker reparative action. It is essential to work outside the limits of the growth to avoid any chance of implantation of the disease. The skin edges should be kept clean and the flap wrapped or covered with a moist warm gauze. The resulting cavity is packed with borated, or better, iodoform, gauze, which remains 5 to 6 days. Gauze wrung out of one of the milder antiseptic solutions replaces this at short intervals thereafter. Healing is more rapid than would be expected, although several months usually elapse before epidermization is complete, after which a prosthetic apparatus can be fitted. Soft food is taken on the third day, and there is no difficulty in maintaining nutrition. If the plate of the hard palate can be saved, the patient is more fortunate in that no apparatus will be necessary.

Among the most malignant cases are some that have been treated with local cauterization, incomplete excision, electricity, and ineffectual forms of radiation.

A number of cases which have been treated with radium and X-ray would, in all probablity, have shown better results if operation had been done as a primary procedure. The genuinely inoperable case should be given the maximum radiation with the hope that it may become operable or respond to radiotherapy. I should not be inclined to favor pre-operative radiation in operable cases.

Suppurative conditions of the antrum may mask a co-existent or causative malignancy. A number of the malignant growths of this region start in nasal or antral polypi, and the portion removed for diagnosis does not always show the cancer. Such was the condition in one of the series of cases shown 4 years ago. All biopsy specimens removed until the last failed to show malignancy. At operation the antrum was filled with carcinoma and the disease had involved the ethmoid cells. This patient is alive and well today, 4½ years after operation. The orbital plate and eye were saved. The photograph will show the condition at present. The disease was squamous-celled carcinoma.

It is especially suggested to the laryngologist and rhinologist, and to the general practitioner and dentist as well, that certain recurring polypoid conditions of the nares and about the antral orifice, as well as persistently ulcerated conditions of the mucosa about the teeth, should be regarded with suspicion. The X-ray will often help in a determination of the condition of the antrum. There are great variations in the malignancy of tumors

and of individual resistance, but our greatest chance of success in this region still lies in the careful eradication of the primary focus together with removal of the regional lymphatics. Postoperative radiation with radium will be of help, and, as has been said, with so-called giant-celled sarcomata may be all that is necessary after a limited resection.

The operation today is not productive of great shock, loss of blood, or delayed convalescence, in the average case, and I feel offers renewed hope and encouragement in this field of surgery where some brilliant successes are recorded in the past and an increasing number will be in the future. The cases reported in November, 1918,[1] are all alive today. The greatest length of time that has elapsed in those cases has been 9 years and the shortest 4½ years. I believe that they may be accepted as cures, for the recurrences that take place are not long delayed. There has been no operative mortality in the series or in cases operated upon since. All but one are alive today. The patient who succumbed 14 months after operation to a wide involvement of the orbital region refused the additional sacrifice of the eye with a clearing out of that region at the time of the primary procedure. Had she done so her chances for recovery would have been multiplied many times. Any involvement of the periosteum necessitates the removal of bone beneath. In addition to the cases of 1918, the histories in brief of three other cases, all traced and seen recently, are given herewith. Another operated upon in 1917 has not been traced and is not included.

W. G., Hosp. No. 115319, S. Chief complaint when seen was inability to breathe through left nostril and the presence of a swelling of the left cheek. Six months previously, the patient had noticed difficulty in breathing through the nose with the mouth shut. He went to a "nose specialist," who removed a portion of tissue for examination. That side became completely closed shortly thereafter. He was told that the trouble was sarcoma and was given radium treatments. The prognosis was bad. The swelling of the cheek remained. Patient sought further advice. He presented a distinct bulging of the cheek on the left side and the left nostril was occluded by a red, rather firm mass attached upon the left side. Transillumination showed antral opacity. The teeth were intact and firm. Family history was negative except that two brothers had had nasal polypi removed. Wassermann negative. No palpable lymphatics. The patient's general condition was good and his hæmoglobin 70 per cent. Operation, September 9, 1916—Cervical glands upon the left side were removed and the external carotid ligated. The maxilla was excised according to technique described. The antrum was completely filled with neoplasm which had invaded and completely filled the left nostril extending up to the ethmoid. The bony walls were involved, and the central portion of the orbital plate was removed.

Diagnosis: giant-celled sarcoma, inflammatory reaction in lymph nodes. The disease was evidently of rapid growth but not of metastasizing variety of this type. Patient left hospital 15 days after operation and has had no X-ray or radium treatment. It is a purely surgical cure. He has had no recurrences or metastases and is alive and well 6½ years after operation. The photographs show the present condition and prosthetic apparatus.

R. B., Hosp. No. 130308, S. For a year before being sent for operation, this patient had had recurring polypi removed from the left side of his nose. He was sent for radium treatment for this condition. A portion of tissue was removed close to the antral orifice and showed squamous-celled carcinoma. The left side of the nose was almost closed. Antrum illumination showed opacity. Glands were palpable upon the left side. Patient in very fair condition, with a hæmoglobin of 65 per cent. Wassermann negative. The operation as described was done. The disease had entered the ethmoid cells, which were opened and cleared out. The antrum contained a solid mass of neoplasm and the bony walls were invaded. A portion of the orbital plate was removed in addition. The cervical lymphatics removed at the same time were free from invasion. This patient has had no recurrences or metastases and is alive and well 4½ years after operation. He has had no postoperative X-ray or radium treatment.

Diagnosis: squamous-celled epithelioma of the jaw. The tumor consists of very much inflamed, œdematous connective tissue into which extend long tubules of squamous cells with pearl formation. The tumor has invaded the bone of the jaw, inciting a considerable rarefying osteitis. This tumor apparently arose from a point at or near the antral orifice. (Figs. 8 and 9.)

M. B., first seen March 15, 1922. Referred by Dr. E. R. Lampson of Hartford, Connecticut. For the last 8 months patient had had some mucopurulent discharge from the right nostril and the last 2 months the discharge had become blood-stained. For 6 months he had noted increasing difficulty in breathing through the right side of nose, which was almost completely occluded by a mass with attachment apparently on the right side. There was a distinct bulging of the cheek. A portion removed showed squamous-celled carcinoma. Patient in very fair condition, Wassermann negative.

Operation, March 16, 1922. The maxilla was excised, leaving the orbital plate and the greater part of the pterygoid portion. Neck dissection and ligation of the carotid had been done at a prior date. The disease filled the antrum and extended above the middle turbinate in the nose and to within a centimeter and a half of the eustachian orifice posteriorly. The cervical and submaxillary lymph nodes were not invaded. This patient has gone but a year since operation but has shown no recurrence or metastasis. The photograph taken a year after the removal of her jaw shows the appearance of the face. She has a well-fitting prosthetic apparatus and has no difficulty with mastication and deglutition. (Figs. 10 and 11.)

No one of these patients had had previous sinus or antral trouble or history of a chronic rhinitis with the exception of the one with the recurring nasal polypi. None had had trouble with the teeth of the upper jaw upon the side of the disease. No one of these had postoperative radium or X-ray treatment. I believe that postoperative radium and X-ray treatment are at times indispensable adjuvants, and when either is employed the application must be thorough.

[1] Annals of Surgery.

MAJOR UROLOGICAL SURGERY UNDER SACRAL AND PARASACRAL ANÆSTHESIA

By OSWALD SWINNEY LOWSLEY, A.B., M.D., F.A.C.S., New York
From the Urological Department, James Buchanan Brady Foundation, of the New York Hospital

STIMULATED by a report on "Sacral Anæsthesia, as applied to Genito-Urinary Surgery" by Parker Syms at the New York Academy of Medicine in February, 1921, that method of inducing anæsthesia has been utilized from time to time in the department of urology at the New York Hospital until we have now developed a method which seems to give excellent anæsthesia in almost every case.

F. Cathelin[1] and Durant (1902) used sacral anæsthesia for the purpose of treating grave neuralgias, sexual neuroses, and incontinence of urine. The former first used plain water, salt solution, and later added cocaine, novocaine, codeine, or morphine. By this method Cathelin reported 49 per cent of the cases of incontinence of urine cured; 35 per cent materially benefited; and 4 per cent failures. He failed in his attempts completely to anæsthetize the sacral nerves in humans but was successful in dogs. A. Laewen[2] used 20 to 25 cubic centimeters of 1½ to 2 per cent novocaine and placed the patient in the sitting posture for some minutes after injection, with the idea of retaining the solution in the lower end of the vertebral canal. O. Gros,[3] recommended the addition of sodium bicarbonate, which he states permits the solution readily to penetrate the nerve sheaths. Strauss prepared his solution by the addition of sodium sulphate which he maintains prevents the decomposition of adrenalin, which he also uses. Hertzler recommends the uses of quinine and urea using 60 to 90 cubic centimeters of 6/10 per cent solution. B. Lewis and L. Bartels[4] reported 48 successful cystoscopies out of 68 attempted and D. R. Pickens[5] reported 81 out of 100 attempted. Splendid work on this subject has been done by Thompson of Galveston who follows the method described by M. L. Harris.[6] Albert J. Scholl, Jr.[7] used sacral anæsthesia successfully in 140 cystoscopies out of 150 in which it was used.

The patients upon whom this type of anæsthesia was first used by us were mostly cases in extremely grave condition upon whom a perineal prostatectomy was performed. They will be mentioned in detail later. In the last series all operations in which the anæsthesia was applicable were done under sacral. This includes operations upon the prostate, seminal vesicles, and urethra. In operations within the scrotum the sacral must be reinforced by blocking off the cord as it emerges from the inguinal canal.

METHOD OF ADMINISTRATION

The following is the routine procedure which we have developed and attempts to deviate from it have caused unsatisfactory results in some way or other.

The patient is prepared for operation in the usual manner as regards purgation enemata, etc.

[1] Les injections spidurales. Paris, Baillière, 1903.
[2] Zentralbl. f. Chir., 1910.
[3] Muenchen. med. Wchnschr., 1910.
[4] Surg., Gynec. & Obst., 1916.
[5] J. Tennessee M. Ass., 1916.
[6] Tr. Am. Surg. Ass., 1917.
[7] J. Urology, 1921, August.

Fig. 1.

Fig. 2.

Fig. 3.

Fig. 4.

Fig. 1. This sacrum shows the usual location of the hiatus.

Fig. 2. This sacrum has its hiatus very high up—a common anomaly.

Fig. 3. The roof of this sacral canal is entirely lacking.

Fig. 4. The hiatus of this sacrum is so compressed that a needle can barely be introduced when it is entirely freed from all organic matter.

One hour before going to the operating room an opium suppository (gr. i) is inserted into the rectum. Just as he starts for the operating room he is given a hypodermic of 7 minims of Magendie's solution. Upon arrival he is placed upon his elbows and knees or upon his abdomen on the table. The skin is then infiltrated at the point where the needle is to be inserted, the skin first having been sterilized in the usual manner.

The operator then palpates the coccyx, and sliding his finger above this bone reaches the lower part of the sacrum and is usually able to palpate the sacral hiatus without difficulty. The sacral horns adorn the lateral borders of a triangle of which the hiatus is the apex. A 6-inch needle is inserted through the anæsthetized skin and into the sacral canal by puncturing the ligament which covers its lower end. After penetrating this ligament the needle is easily pushed in 1½ to 2 inches. It has to be guided carefully otherwise it will impinge on bone and must, of course, be deflected. One learns to tell by the ease with which the needle passes and the direction it takes whether it is in the canal. One of the directions the needle may take is just over and to one side of the roof of the canal. This error is detected by the direction of the needle and the fact that it passes with difficulty. One can also check up on this position, if improperly inserted, by the fact that as soon as the injection is started the tissue at the end of the needle will infiltrate with the solution.

The sacrum has a great many variations in different individuals and a careful study of the osteology as well as the course of the nerves is a necessary preliminary investigation.

The needle having been inserted into the canal, one observes its end carefully to see whether either blood or spinal fluid runs out. In the event of this complication the needle is withdrawn to a point where it ceases to appear and the injection made. If the solution runs in easily one is sure that he is in the canal. If, however, the injection is made with difficulty one is quite sure that the needle is not in the canal and the tissues over the sacrum are observed for infiltration.

We have been using 30 cubic centimeters of freshly prepared 2 per cent novocaine solution injected into the canal without the addition of sodium bicarbonate solution. We have not used adrenalin in the injected solution because we have preferred to have it in reserve in case of collapse from the toxicity of the drug.

The injection into the canal is extradural and presumably elevates the dura from the bone under the pressure used. In this procedure one may safely use a quantity up to 60 cubic centimeters provided the solution is not toxic. We then inject 1 per cent solution of novocaine into the first, second, and third sacral foramina on each side in accordance with the method of Labat. The foramina are located rather easily by passing the needle into the depression just below the transverse processes and by pointing it mesially and slightly upward ones needle usually enters without great difficulty. From 5 to 10 cubic centimeters of 1 per cent novocaine solution is injected into each foramen the needle being withdrawn in order to distribute it in the entire length of the foramen.

The patient is then placed on his back and 20 minutes by the clock is allowed to elapse before the operation is begun. By this time that part of the patient which sits on a saddle including the scrotum, urethra, and bladder should be thoroughly anæsthetized, if the injection is successful.

Scholl has timed the appearance of anæsthesia as follows:

	Minutes
Ano-scrotal region	4
Posterior surface of scrotum and penis	10
10 to 12 centimeters laterally on inner surface of thighs	10
Sphincter ani, sacrum, and buttocks	10
Anterior urethra	12
Meatus and internal sphincters last to become anæsthetized, maximum anæsthesia in	20–25

We have found that by starting to operate too soon the patient will often feel pain and such an apprehensive state of mind will be produced that every movement will cause complaint. On the other hand, if one waits until a thorough anæsthesia occurs, the patient goes through operation without a protest.

DESCRIPTION OF CASES

First Series (6 Cases)

In this series novocaine, 40 cubic centimeters of 2 per cent solution, was injected into the sacral canal only. This type of anæsthesia was used because it was believed that the patients, in most instances, could not stand an inhalation anæsthesia of even gas or oxygen.

The cases included one Young's punch operation, one suprapubic prostatectomy, one perineal prostatectomy for carcinoma of the prostate, and three perineal prostatectomies for adenomatous hypertrophy of the prostate. On account of the frail condition of Cases 2 and 3 mentioned above, operation under inhalation anæsthesia would have been impossible. After six operations

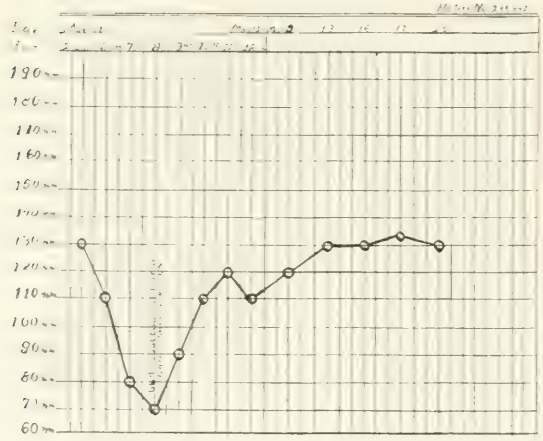


Chart 1. This case had a serious slump in blood pressure following prostatectomy under gas-oxygen anæsthesia. Relieved by gum glucose.

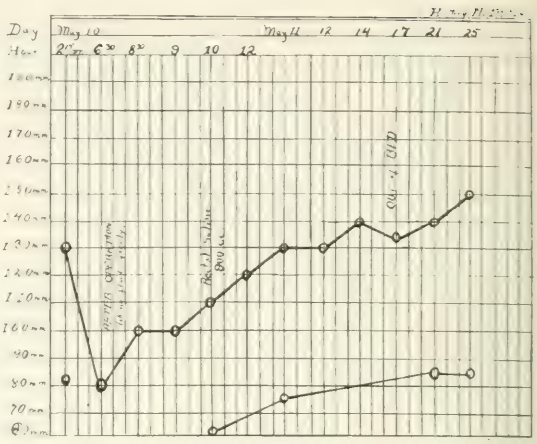


Chart 2. Operation on this patient was started under sacral anæsthesia and finished under gas-oxygen. Profuse bleeding occurred throughout operation. Recovery without gum glucose.

were performed as above, sacral anæsthesia was given up because it was not a painless procedure and no cases arose which made such an anæsthesia imperative. Case 2 is of sufficient importance to outline briefly.

Patient, married, admitted January 25, 1921; discharged April 14, 1921. Diagnosis: enlarged prostate. Operation: suprapubic prostatectomy.

At age of 12 patient had stone in bladder which was removed through urethra. Twenty years ago he had non-specific urethritis of 2 weeks' duration.

Present illness. Patient in uræmia and unable to answer questions. History elicited from his family. One year ago he had frequency and pain on urination. Two months ago he suffered an attack of acute retention and his health since that time has failed until now he is unable to work. He has severe vesical tenesmus, no hæmaturia, but complete retention of urine for past week.

On January 26, a suprapubic cystotomy was done under local anæsthesia, and suction drainage applied. Patient suffered no postoperative hæmorrhage or vomiting.

January 30: There is some congestion in posterior region of right lung.

February 12: Patient out of bed practically all day but has few moist râles in left chest.

February 15: Temperature 101 degrees. Chest clear.

February 18: Flatness in posterior region of left lung. 4.4 cubic centimeters of bloody fluid aspirated with relief to patient.

March 1: Again aspirated but no pus or fluid obtained.

March 3: X-ray shows no fluid in pleura.

March 6: Patient out of doors for walk.

March 19, 1921: Suprapubic prostatectomy under sacral anæsthesia. Six grains novocaine. The abdominal wound was very well anæsthetized over whole area. Infiltrated with novocaine. The prostate was easily removed. Patient stood operation well. One hundred cubic centimeters of gum glucose solution was given intravenously during operation and aromatic sprits of ammonia after operation overcame shock. No postoperative hæmorrhage or vomiting. Patient made an uninterrupted recovery and was discharged from the hospital April 14, as completely cured. Was seen at return clinic in February, 1923, and has returned to work and feels perfectly well.

SUMMARY OF CASES

Since February 3, 1923, 76 cases have been operated upon under sacral and parasacral anæsthesia according to the method described above. Fifty of these were perineal prostatectomies, four prostatotomies for abscess, five seminal vesiculectomies for abscess of the seminal vesicles, three Young punch operations for enlargement of the subcervical group, five urethrotomies for stricture, one hydrocele, the latter performed at the Lexington Hospital, and eight cystoscopies. All of these cases were entirely successful except six. In one of the latter, viz., the seminal vesiculectomy, it was necessary to give a few whiffs of ether during the last 5 minutes of the operation. In another one, that of a man 86 years of age upon whom a perineal prostatectomy was performed, a little gas or ether should have been used for about the same length of time. The other cases were only moderately uncomfortable and when asked after the operation whether we hurt very badly, "not so bad" was the usual answer. In the case of excision of the hydrocele sac the cord had to be blocked off with novocaine as it emerged from the external ring, as the skin of the scrotum only was anæsthetized by the sacral and parasacral anæsthesia. In two of the unsuccessful cases we attempted some deviation from the routine method of procedure. Parasacral infiltration alone is not sufficient. One per cent novocaine used in the sacral canal was also a failure.

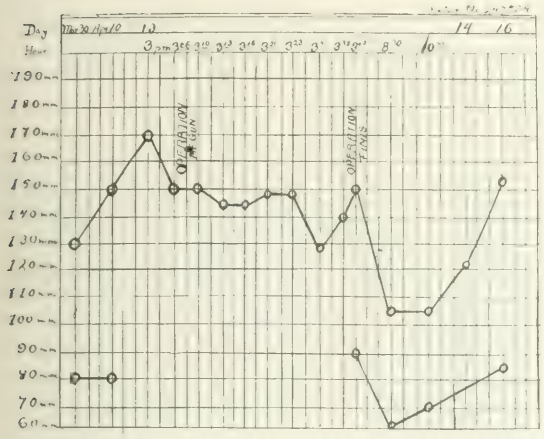


Chart 3. A typical blood pressure chart of a case of prostatectomy under sacral anæsthesia. Rarely has the blood pressure dropped below 100 millimeters mercury.

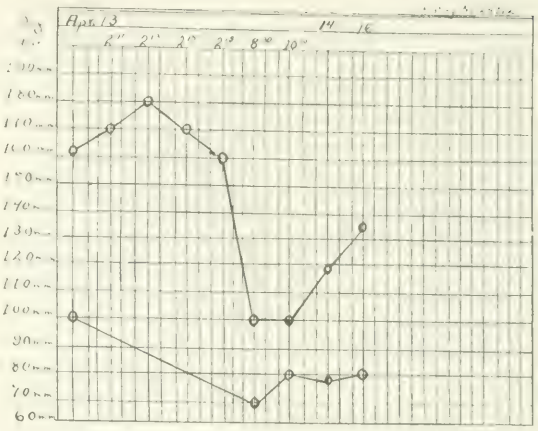


Chart 4. Shows the typical slump after a Young punch operation under sacral anæsthesia. It is not so extensive as with any inhalation anæsthesia.

In the seventy thoroughly successful cases the operation apparently passed by unnoticed, except in a few instances in which the patient stated that there was no pain but he could feel a pulling sensation. Three or four of the patients actually dozed off during the operation. An important observation is that the bleeding during prostatectomy, which is fairly profuse by every method, is much less than that noted when gas-oxygen anæsthesia is used, due presumably to the fact that the blood pressure is not nearly so high when the patient is under sacral anæsthesia. Five-minute readings were made during several cases, and typical curves are shown in Charts 1, 2, and 3.

UNTOWARD SYMPTOMS

Two cases have had short periods of excitement. One had spasmodic contractions of the legs lasting about one minute. Two others became flushed and somewhat confused temporarily. Most of the cases have an increase in pulse rate and slight increase in blood pressure which lasts throughout the operation.

The untoward symptoms in our cases appeared immediately after the injection was given into the sacral canal. Adrenalin is always held ready for use in case a collapse occurs. We believe in holding it in reserve as a stimulant in case of necessity and hence do not use it in the original solution injected.

E. Zweifel[1] reported a death from cardiac and respiratory paralysis due to the injection of 0.8 gram of novocaine into the dural space. His needle had penetrated the dural sac.

[1] Muenchen. med. Wchnschr., 1920.

B. Kroenig,[2] reported a case in which the novocaine was injected into the sacral vein. This was followed by a partial respiratory paralysis.

LENGTH OF TIME AFTER INJECTION DURING WHICH ONE MAY OPERATE

As stated above it is our invariable custom to wait for full 20 minutes before beginning to operate. The anæsthesia seems to be deepest at about 30 minutes and continues to be entirely satisfactory for two hours after injection. Dr. Parker Syms[3] makes it a practice to wait for about an hour before beginning to operate. He believes that the anæsthesia lasts for several hours.

In one case, that of a seminal vesiculectomy, we felt that the anæsthesia was wearing off at the end of 1 hour and 20 minutes and were obliged to give a few whiffs of ether during the last 5 minutes of a long difficult operation performed by one of my associates, Dr. Delzell.

POSTOPERATIVE COURSE

We have not yet had a death in any of our cases of either series. In the first series were two cases that could not have been operated upon except by means of sacral anæsthesia as they were in no condition to withstand inhalation anæsthesia of any sort. In the last series of 70 patients there is one such case. We have felt for some time that blood-pressure readings are much more important in postoperative observations than any other feature of the immediate recovery. It has been a surprise and delight to observe this

[2] Operative Gynaekologie, Leipzig, 1912.

[3] Internat. J. Surg., 1921, June.

series of cases. In none of the second series has the blood pressure dropped below 100 millimeters mercury, and all of them have shown a tendency to rise at the danger period, about 6 hours after operation. We have not found it necessary in any of these cases to give stimulation to the circulatory system either by means of drugs, intravenous infusion of gum glucose, or any other substance.

The general appearance of the patients on the day following operation by this method is surprisingly good and it would seem that the shock to the entire body mechanism is very considerably reduced by avoiding inhalation anæsthesia.

There have been no late developments such as headache, paralysis, or other alarming effects. Thus far our patients seem to improve from the zero postoperative hours, 6 to 10 after operation, without interruption.

One of our cases developed a cellulitis of the tissues over the scrotum which was due apparently to the improper sterilization of the novocaine used.

CONCLUSIONS

Our series is much too small to draw general conclusions. Our observations and the experiences of others lead us, however, to believe that:

1. Sacral combined with parasacral anæsthesia is the anæsthesia of choice in performing major urological operations *per perinæum*, particularly prostatectomy.

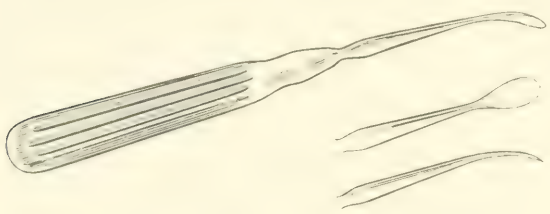
2. In perineal prostatectomy under this type of anæsthesia there is less bleeding and less shock than there is with any inhalation anæsthesia.

3. It is apparently safe and effective if given properly.

AN INSTRUMENT TO FACILITATE BUNION OPERATIONS AND SESAMOIDECTOMY

By PHILIP LEWIN, M.D., Chicago

THIS paper is not concerned with the symptoms, pathology, and indications for hallux valgus operations or sesamoidectomy. It is a brief description of an instrument to expedite



these operations. The instrument was described in a paper in the April, 1918, issue of Surgery, Gynecology and Obstetrics. Dr. J. L. Porter and the writer have used it in a great many hallux valgus operations with gratifying success. The writer has since applied its use to the operation of sesamoidectomy and has found it extremely useful. It is well known how difficult it might be at times to dissect a sesamoid from its tendinous attachments on the plantar surface of the first metatarsal head. The technique of the operation is as follows:

An incision is made along the edge of the sesamoid and that structure is grasped by means of an Allis forceps or preferably a Backhaus forceps. The herein illustrated dissector is then easily passed around the bone which can be quickly shelled out. The shape of the instrument corresponds very closely with that of the sesamoid.

THREE AIDS TO RENDER THE CONDUCT OF LABOR MORE SCIENTIFIC

By JOSEPH B. DeLEE, M.D., F.A.C.S., Chicago

THE terms obstetricians use to convey to others the ideas of the mechanism of labor, e.g., the degree of engagement of the presenting part, the degree of rotation, the stage of dilatation of the cervix, are very vague and unscientific. They are especially unsatisfactory for permanent records and for teaching students.

One of the most important elements of a given diagnosis is the determination of the degree of engagement. The usual terms—"head floating"; "head engaged," "at the outlet," etc., certainly do not convey the same impression to any two different minds.

In order to express in understandable scientific language the exact station of the head, the writer has devised the plan shown in Figure 1.

A vertical coronal plane is imagined passing through the spines of the ischium. This plane is divided into centimeters and numbered as shown in the illustration. The interspinous line is zero. The centimeters above are minus, those below, plus. If the lowest portion of the head (not the caput succedaneum) has reached the spines, i.e., just engaged, we say the head is "engaged at zero, O." If it is higher we say it is "not engaged, minus 1, or —2, —3," or shortly, "head —3." If it has passed "O" we say it is "engaged, plus 1 or +2, +3," etc., or shortly, "head +3."

Naturally the application of this method is subject to the rules governing engagement imposed by the type of pelvis and the nature of the presentation, to all of which it is easily adaptable.

The need for a clear objective method for conveying to others the degree of rotation of the presenting part, especially in teaching students the mechanism of labor, and in explaining to graduates the intricacies of forceps operations, has led the writer to devise the procedure shown in Figure 2. The usual method of designating the various positions, O. L. A., O. D. P., etc., is good as far as it goes. The plan suggested refines this part of our art. The pelvis is laid on a circle with radii marking the degrees. The pubis is zero "O", the sacrum, 180°. With this plan O. L. A. would be O. L. 45°, O. D. P. — O. D. 135°, O. L. T. — O. L. 90°, etc. One can thus designate every stage of rotation, e.g., O. L. 15°, O. D., 110°, O. L. 175°, etc., and the figure stated represents the arc the occiput must travel to complete anterior rotation.

Of all expressions those referable to the stage of dilatation of the cervix are the most vague and questionable. "The effacement is half complete," "the cervix admits 2 fingers," "the os is the size of a dollar," "the palm of the hand," etc. These examples show how unscientific and circumlocutionary our present terms are. To obviate this and to enable the teacher to convey to the pupil, and the examiner to record, with objective clarity, the findings of rectal and vaginal examination, the writer developed the plan shown

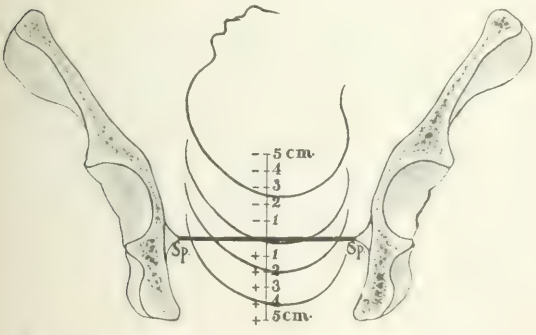


Figure 1. Determination and designation of the degree of engagement.

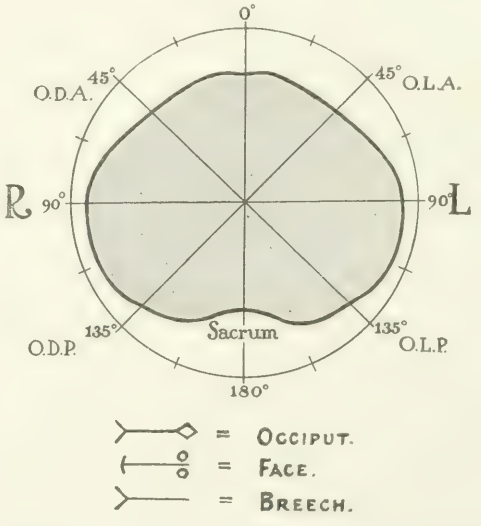


Figure 2. Determination and designation of the degree of rotation.

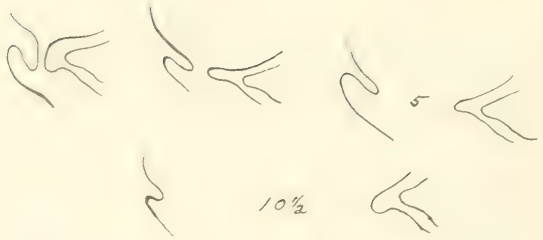


Figure 3. Pictorial representation of effacement and dilatation of cervix.

in Figure 3. These simple sketches are easily learned and in a few seconds all the needful information regarding the effacement and dilatation of the cervix can be conveyed to others and at the same time recorded. By putting in the numerals 2, 4, 7, 9, in the sketches, the growing enlargement of the cervix can be followed.

All three of these procedures have been in daily use at the Chicago Lying-in Hospital and Dispensaries for over 5 years and are giving increasing satisfaction all of the time. To render them practicable, a centimeter ruling and example sketches of the cervix are printed upon the margins of the history sheets and several reproductions of the graduated circle (Figure 2) are inserted where the results of the examinations are to be recorded.

THE USE OF FAT TO PREVENT SUTURES CUTTING INTO PARENCHYMATOUS ORGANS BY UNDERPINNING

With Special Reference to the Suture of Nephrotomized Kidneys

By EDWIN BEER, M.D., F.A.C.S., New York

SOME three years ago, in discussing the closure of accidental or operative wounds of the liver, spleen, and kidney, I called attention to the fact that sutures could be underpinned or supported with fat or fascia so that bleeding could be well controlled without any danger of the sutures cutting into the sutured organ. I had used this method in kidney work for several years and found it particularly ideal in decapsulated kidneys, in which sutures so regularly cut through the parenchema and may be of little value in controlling bleeding. In looking up the literature at the time, I was interested to see that Da Costa, on page 1426 of his *Modern Surgery*, 1919, illustrates a very similar method of underpinning with catgut strands, in closing nephrotomy incisions. He calls this method which prevents the cutting through of the suture "Stellwagen's method of suture." According to the illustration in Da Costa's book, the suture is applied slightly differently from the method employed by me, and perhaps with the suture identified as Stellwagen's, more kidney parenchyma is destroyed than by the method to be described. I have used this method a large number of times, and in view of the limited amount of kidney necrosis induced by the use of this stitch, I have made use of it regularly, not only in decapsulated kidneys but in kidneys still covered with their capsule. Recently E. Hagenbach[1] has described a method of suturing the kidney which is practically identical with the method described by me, and expresses great satisfaction with the results. The accompanying illustration shows very clearly the different steps of the operation, the illustration having been made by one of my house surgeons almost 3 years ago.

[1] Ztschr. f. urol. Chir., 1923, Feb. 17.

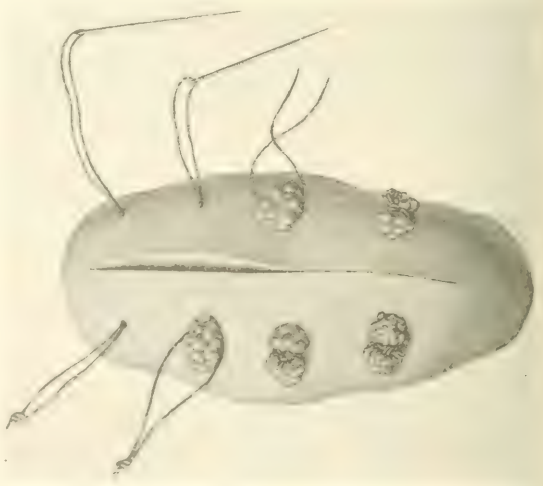


Figure 1. Technique of underpinning chromic gut (with fat) hæmostatic sutures following nephrotomy.

To close the incision in the kidney, or for that matter the spleen or liver, some fat from the adjacent wound is excised and cut into fair-sized masses. A fairly heavy chromic stitch with the two ends of the stitch tied together is passed deeply through the part to be sutured, so that the kidney, or other organ, has a double thread of chromic gut running through it. Before pulling the loop up to the organ that is being sutured, one piece of fat is slipped under the loop and then the suture is drawn tight. On the other side of the organ where the needle has been brought out, between the two loops of chromic gut, another piece of fat is placed and over this the two ends of chromic gut are tied after removing the needle. This knot can be pulled up as tight as required to control the bleeding, and as the stitch is underpinned on both sides, there is very little chance to cut into the parenchyma. In view of the fact that no tissue is throttled by the passage of the suture, as is the case in mattress sutures, very little kidney parenchyma is destroyed by this method of closure. In addition to these deep sutures, the edge of the nephrotomy incision is closed with either continuous interlocking or interrupted chromic gut sutures.

In such wounds as above described, it is to be highly recommended and is regularly used in kidney surgery by my staff. Up to date there has been no opportunity to apply it to wounds of the spleen or liver, but from the experience obtained in kidney surgery, one would expect very satisfactory results in the other organs.

INTRAPERITONEAL HÆMORRHAGE IN THE NEWBORN FOLLOWING THIES' METHOD OF RESUSCITATION

By M. P. RUCKER, M.D., and S. W. BUDD, M.D., Richmond, Virginia
From the Departments of Obstetrics and Pathology of the Johnston-Willis Sanatorium

JOHANN THIES[1] has described a method of resuscitation for the apparently dead newborn and those in white asphyxia. His investigations and those of Welker, Schueckling and Seitz have shown that in the newborn there is a comparatively small amount of blood (one-fifteenth to one-nineteenth of body weight), and with delayed tying or clamping the cord, the quantity of blood in the infant's body is increased some 25 per cent. In two cases of stillbirth, Thies found as much as two-thirds of the fetal blood in the placenta and umbilical cord. It occurred to him that it would be advantageous in many ways (raising the blood pressure in the right side of the heart, improving the circulation in the lungs and in the centers in the medulla), to milk this blood from the placenta into the fetus. He states that each stroking of the cord toward the body is followed by a strong pulsation of the heart that is often visible. He has used this method of *Autobluttransfusion* for 10 years and reports his results in the last 35 cases. Of these apparently dead babies, 34 were resuscitated. Six of them, however, died in the first week.

Thies' theory is an attractive one, but that the method is fraught with some danger, the following case would seem to indicate. The father had several years before his marriage a rather disconnected treatment for syphilis, and it was a question in the mind of the referring physician whether he had been completely cured. The mother was in excellent health. Her blood Wassermann was negative, as were also the physical, pelvic, and urine examinations. This was her first pregnancy. She went into labor shortly after the administration of castor oil. It was a breech presentation, and an easy extraction was done under ether anæsthesia, shortly after the cervix was completely dilated. When the buttocks appeared, it was noticed that the testicles were greatly enlarged. The child was in white asphyxia, and as much blood as possible was milked from the cord into the body. The cord was then clamped and cut and an attempt was made to resuscitate him with a lung motor. This was unsuccessful, and the child went into rigor mortis while we were still working upon him.

Autopsy showed approximately 200 cubic centimeters of clotted blood in the periotoneal cavity. Unfortunately the abdominal incision severed the umbilical vein in several places, so that it was impossible to say from just where the blood came. The brain and other organs were markedly ischæmic, but showed no other changes. The testicles showed a myxomatous degeneration, such as is seen in congenital syphilis. There was marked hyaline degeneration in the blood vessels of the placenta.

[1] Thies, Johann. Zur Behandlung des Scheintodes beim Neugeborenen, Zentralbl. f. Gynaek., 1920, lxiv, 607.

EDITORIALS

SURGERY, GYNECOLOGY AND OBSTETRICS

FRANKLIN H. MARTIN, M.D. ..... Managing Editor
ALLEN B. KANAVEL, M.D. ..... Associate Editor

NOVEMBER, 1923

AUTO-INFUSION OF BLOOD FROM THE SPLEEN IN CASES OF SPLENECTOMY

THE operation of splenectomy is still attended with a fairly high mortality. To reduce this mortality to a minimum is the object of all surgeons within whose sphere of work such operations are performed. The high mortality is mainly due to the pathological changes in the blood, and to the more remote pathological conditions induced by the altered state of the blood. In order to diminish the risk of operation, patients have been transfused with whole or citrated blood once or many times before operation, and gratifying results have followed.

In many of the conditions necessitating removal of the spleen the organ is found to be enlarged, sometimes considerably. The amount of blood such an enlarged spleen contains must represent a considerable proportion of the patient's total blood. Even though the plan is adopted of compressing the splenic artery for a few beats before clamping the pedicle or ligating the vessels, the volume of blood still retained in the enlarged spleen would represent a large proportion of his total blood. The loss of so much blood to a patient already suffering to some extent from anæmia, even though one or several transfusions of blood may have been performed, might be the means of turning the scale of the balance against him, after the operation of splenectomy.

In July, 1922, my friend and former colleague in the Meath Hospital, Dr. Henry Stokes, suggested to me the consideration of reinfusing the blood from the spleen into a patient on whom I intended to operate. The case was that of a man about 50 years of age who was suffering from advanced Banti's disease. The spleen was greatly enlarged, and cirrhosis of the liver was marked. I thoroughly approved of the idea, and on the morning of the operation a solution of sodium citrate (160 cubic centimeters of a 3.8 per cent solution) was prepared, half the amount being placed in a sterile basin. Directly I had secured the pedicle of the spleen between clamps Dr. Stokes took charge of it and held it over the basin containing the citrate solution. The clamps were removed and the blood flowed from the spleen into the basin. A little gentle circumferential pressure facilitated the flow. When it was seen that the volume of blood was considerable, the remaining 80 cubic centimeters of citrate solution was added. The citrated blood was then transfused into the patient's median basilic vein while I closed the abdomen.

The total amount of fluid transfused was more than 800 cubic centimeters. The net result was that the patient was placed in bed with at least 650 cubic centimeters of blood of which he would otherwise have been deprived. The procedure certainly greatly improved his chances of recovery.

Several reports of re-infusion of extravasated blood in cases of ruptured tubal pregnancy, traumatic rupture of the spleen and liver, and injury of the mesenteric vessels, have appeared in literature during the last 2 years, but I have not seen this idea of Dr. Stokes' suggested.

Blood shed into the tissues, even into the peritoneal cavity, rapidly undergoes changes, and clotting quickly takes place. For this reason I feel sure that most of the fluid re-infused in these cases is merely serum with the hæmoglobin dissolved out of the red cells. It has no oxygen-carrying power and is not altogether devoid of danger, whereas, in a case of splenectomy the blood cannot be altered in any way, since it simply flows from the severed splenic vessels into the sodium citrate solution.

I believe this method of re-infusion of the blood from the spleen will eventually become a routine part of the operative procedure of splenectomy performed for all conditions other than traumatic rupture, torsion of the pedicle, or malignant disease.

WILLIAM TAYLOR.

DUBLIN TODAY

ON a recent trip abroad I went first to Ireland. I wished to see again this country of four and one-half million people whose influence has been world wide. Ireland not only has furnished Great Britain men who have made her armies and navies famous, but she has given the world great liberators, men of fiery patriotism whose commemorative statues adorn the countries of their adoption, in the north and south, and in the east and west. Sons of Ireland have enriched immeasurably literature, the sciences, and the arts. Unfortunately, while the services the Irish have rendered to other countries have won them undying fame, at home they have suffered for a thousand years from continuous political disturbance which has marred the history of their country. Truly free at last in essentials, the Free States of Ireland have a responsible government of their own choice corresponding closely to that of Canada, Australia, New Zealand, and South Africa. After taking a conspicuous part in every great war of civilization, Ireland is now successfully coming through her first civil war, under the leadership of Timothy Healey, the Irish patriot who for forty years has fought for Irish Home Rule in the Parliament of England.

The greater part of my time in Ireland was spent in Dublin. On entering the city one is impressed with the wreckage of many of the beautiful old buildings designed by the great architect Grandon. Fortunately, the University of Dublin, with its beautiful campus, and dignified buildings in the heart of oldest Dublin, was not damaged during the recent civil riots. Trinity College, on this campus, coequal with Oxford and Cambridge, with which it exchanges students, is more than 330 years old. The University Medical School, housed in fine buildings, enrolls about four hundred students, all of whom are of collegiate grade.

The National University of Ireland, founded about 25 years ago, has beautiful buildings, which are now to a considerable extent occupied by the Government because of the destruction of the public buildings which were devoted to governmental purposes.

The medical school in connection with the Royal College of Surgeons and the Royal College of Physicians was established in 1790, and in it many of the great medical men of Ireland have been trained.

In spite of the trials and tribulations of war-scourged years the medical men of Dublin are well organized and hard at work.

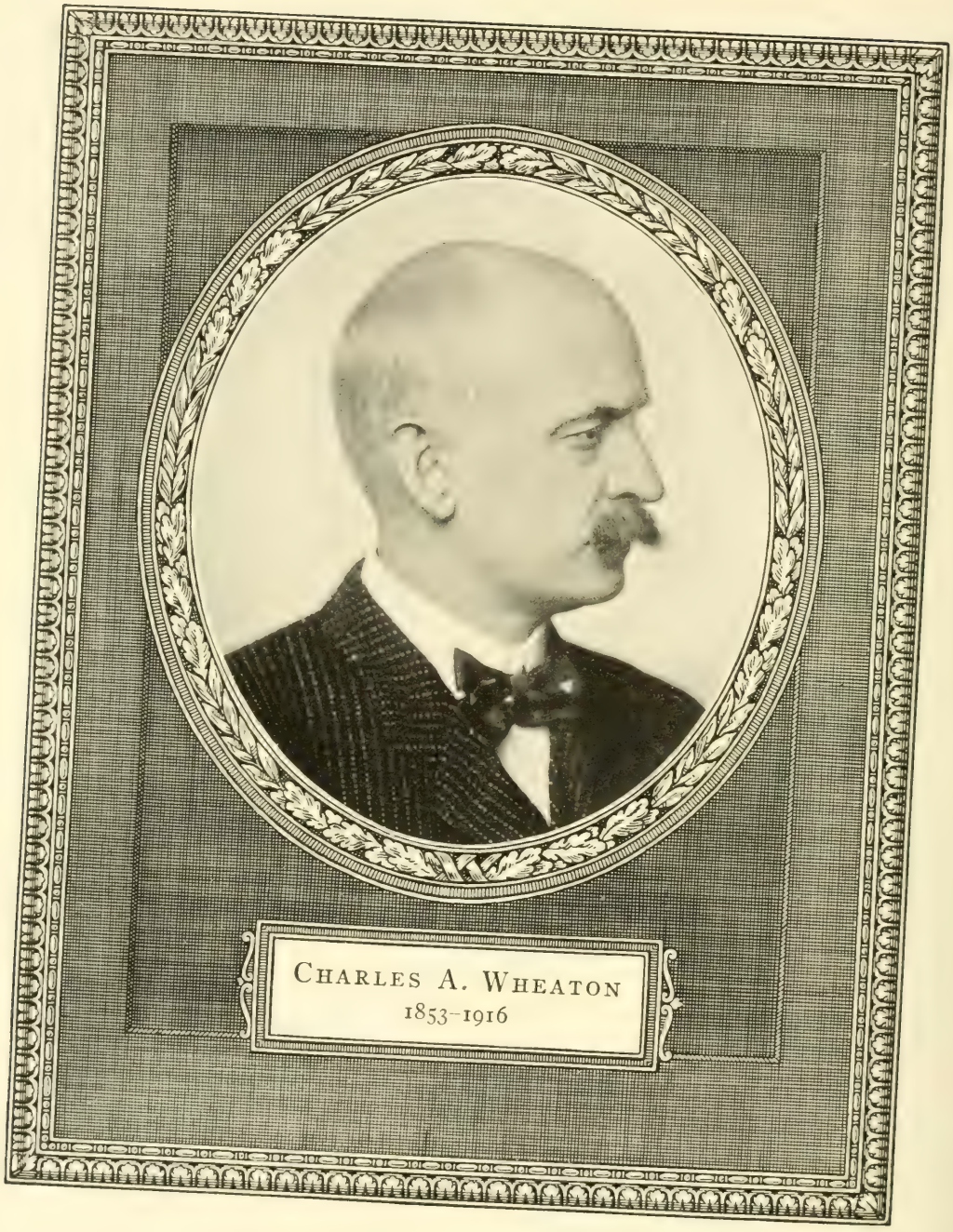
The hospitals are well equipped and have in operation excellent three-year training schools for nurses. There are a number of hospitals in Dublin but none large, the average having approximately one hundred and twenty beds. They are all essentially charitable institutions, although many patients are partly self-supporting, so far as the hospitals are concerned. The Meath Hospital is one of the oldest. It was here that Graves did his work on goiter, and Stokes made his discoveries regarding the heart and circulation. In the Stevens Hospital, Colles did his early work in connection with the fracture that bears his name. In the hall of the Royal College of Physicians there are a number of fine portraits and statues, among which are to be found those of these three pioneers in medicine. The Royal College of Surgeons has notable buildings worthy of the great work carried on by the society.

I greatly enjoyed my visit with the Honorary Fellows of the American College of Surgeons in Dublin. Sir Thomas Myles has retired to his favorite amusement of yachting, so far as his devoted clientele will permit him. He justly achieved a great reputation in surgery, and as a speaker he possesses eloquence of a high order. Sir William Taylor, regius professor of surgery of the University of Dublin, is connected with Sir Patrick Dun's Hospital, where he conducts most interesting clinics. Sir William is a gifted teacher and surgeon. I heard him give a graphic description of infantile intussusception, stressing the sudden crying out of the child, the pallor, the vomiting, and the explosive movements from the bowels. In none of his cases has he had recurrence after operative reduction. In performing splenectomy in cases of anæmia he immediately transfuses the free blood in the spleen to the patient. He has had noteworthy success in handling cases of acute obtruction of the bowels, using a high enterostomy, with two tubes, for the purpose of emptying the toxic contents of the bowel, and of nourishing the patient.

Sir Robert Henry Woods at Sir Patrick Dun's Hospital demonstrated excellent results following maxillofacial surgery. He has performed a large number of laryngectomies for malignant disease, with a low percentage of mortality and a high percentage of excellent functional results. Sir William I. de Courcy Wheeler, president of the Royal College of Surgeons of Ireland, comes of a celebrated family of surgeons. For many years his father occupied the chair of surgery of the medical school of the Royal College. Sir William is a surgeon of great skill, and has in a high degree the friendliness and kindness of heart so characteristic of his race.

I greatly enjoyed a visit to the Rotunda Obstetrical Hospital, of about one hundred and twenty beds, which, for half a century, has maintained its reputation as the most famous obstetrical hospital in the world. The Master of the Rotunda, Dr. Ernest Hastings Tweedy, who always emphasized that parturition is a physiological process, has just retired. He has made many great contributions to the scientific literature of obstetrics, especially in connection with eclampsia and sterility. Dr. Gibbon Fitzgibbon is his worthy successor to the headship.

W. J. Mayo.



CHARLES A. WHEATON
1853–1916

MASTER SURGEONS OF AMERICA

CHARLES A. WHEATON

DOCTOR CHARLES A. WHEATON was born in Syracuse, New York. He was one of a family of fifteen who immigrated to Minnesota. His father settled at Northfield.

His education was gotten in the local schools of Northfield and from his older sisters, two of whom were teachers. He was not a college man. His father was a literary man, being an editor for many years. As a boy he was surrounded with literary people. As a consequence, his love for literature was pronounced even at an early age and continued throughout his entire life. While still young he conceived the idea of becoming a surgeon, but for financial reasons he was unable at once to begin his medical education. He became a railway express messenger in order to earn enough to take him through college and while acting as such he carried in his grip Gray's *Anatomy* and Yeo's *Physiology*, both of which he mastered at odd hours in his work. After a few years he had accumulated sufficient funds to enable him to matriculate at Harvard Medical School. After graduating from Harvard he spent 2 years in the Massachusetts General and Boston City Hospitals, before coming to St. Paul in 1879 to practice his profession.

He early allied himself with Dr. J. H. Stewart, an old practitioner, an able man and extremely popular. Through this alliance Doctor Wheaton was enabled at once to plunge with enthusiasm into the practice of his chosen profession and very soon was able to cull from a large general practice surgical material of a very general character. With this material at hand he early demonstrated his great surgical ability.

As a general practitioner as well as a surgeon, he was especially noted for his clinical ability and for his remarkable personality, a personality which inspired absolute confidence on the part of his patients and of his confrères.

As a diagnostician he had no superior. His interpretation of clinical signs was exact to a remarkable degree and, he depended throughout his entire career more upon clinical signs than upon laboratory or other aids in diagnosis. He deplored the growing tendency of the younger men to depend too much upon laboratory and X-ray or machine-made diagnosis.

He was a pioneer of the Northwest in antiseptic and aseptic surgery and stood head and shoulders above any other man of his community.

As one of the founders of the present Medical Department of the University of Minnesota, he was an enthusiastic teacher for a quarter of a century. His lectures were carefully prepared, often illustrated by his own drawings, and always couched in classical language. He was an indefatigable reader and had at his tongue's end the literature of any subject on which he lectured. To those fortunate enough to hear him, his lectures were a privilege and an inspiration.

Always progressive, he was foremost in the organization of many medical societies in the city and throughout the Northwest. He was ethical to a degree and he hated anything in medicine that smacked of the charlatan or of quackery.

He was charitable to his professional brothers who had not had the opportunity; he could not condone dishonesty or carelessness. For the fads and fancies of surgery he had little patience and was outspoken in condemnation of all such.

At the operating table he was master of every situation that might arise. His anatomical dissection while operating was a joy to the onlooker. His courage and boldness were remarkable. His quickness and deftness was unsurpassed. His experience in surgery was tremendous, and it is to be deplored that throughout his active professional life he was too busy to record his cases or to contribute, to any great extent, to the literature of the day. He himself often deplored his inability to find time to write. His great fund of knowledge, acquired from his own long experience and through his study of the surgical masters, commanded the respect of the entire profession of the Northwest.

He was much sought as a speaker in the many medical and surgical societies of Minnesota and adjoining states. Outside of the medical profession his great vocabulary and command of language made him much sought as a postprandial speaker. Few men equalled him as an after-dinner talker and story teller. His stories were always apropos and their verbal embellishment was a work of art which could be appreciated only by those who had heard him.

He was a genial, companionable man, fond of the good things of life and happiest when extending hospitality and good cheer to his friends. He was a lover of nature, and would often steal away from his active work to spend a few days or hours in the fields or on the streams. During the latter part of his life he was in ill health and spent most of his time in the South during the winter, and on the beautiful Brule River in the summer.

No man of his time was so universally beloved and respected as was Dr. C. A. Wheaton and no man was more deserving.

Whether they know it or not, or whether they appreciate it if they do know it, it remains a fact that the trail he blazed through the wilderness of ignorance in surgery has made it comparatively easy for those of the generation following him. He was a self-made man and he put surgery on the map in the Northwest. His memory and his accomplishments will endure forever.

John T. Rogers.

BOOK REVIEWS

A CRITIQUE OF NEW BOOKS IN GYNECOLOGY AND OBSTETRICS

By GEORGE GELLHORN, M.D., F.A.C.S., St. Louis

MEDICAL works, as a class, rather generally lack that indefinable quality which in books of a different character—fiction, travel, autobiographies—we call *charm*. The medical author, as a rule, feels himself hedged in by too many inhibitions. Chief among them is the desire for strictest objectivity, and where every word has to be weighed carefully lest it lay itself open to criticism, spontaneity is naturally lost to a certain degree. By speaking of himself exclusively in the third person throughout the length of a fat tome, the author achieves a definite, though rather tiresome impersonality but, on the other hand, he foregoes the direct touch with the reader.

Particularly gifted writers know how to break these somewhat traditional fetters without detriment to the scientific value of their works, and make of the acquisition of knowledge a matter of keen enjoyment. I well remember from my college days how the textbook by Fritsch rendered the study of gynecology a genuine delight.

To this category of medical books with a distinct and pleasing personality belongs the new work by Kerr on gynecology.[1] There is a directness and simplicity of diction which makes you feel that you are listening to a genial host while he is sharing his wide experience with you. The personal note is still further enhanced by the numerous case abstracts wherein successes are not overaccentuated and mistakes or failures frankly admitted.

In its general outline the book follows, on the whole, the usually accepted plan. The first and largest part, entitled Clinical Gynæcology, contains twenty chapters in which anatomy, methods of examination, physiology, general symptomatology, and the pathology of the various organs are discussed. Interspersed are chapters, by able collaborators, on subjects regarding which the author "did not feel competent to express definite opinions." This refers to embryology, nervous disorders, venereal diseases, anæsthesia, and transfusion.

The second part deals with medical treatment and remedies, and the third with operative gynecology. This second part is rather short, which is all the more surprising as the author everywhere exhibits a wise conservatism which, contrary to prevailing tendencies, makes full use of non-operative methods. This is very evident, for example, in retrodisplacements where the much-ridiculed pessary is accorded its legitimate place. It is interesting to read that in mild degrees of uterine prolapse, excellent results were obtained by paracervical injections of sulphate of quinine. "The essential detail in the treatment of endometritis is not curettage, but disinfection of the uterus." That Kerr uses pure carbolic acid for this purpose without attempting to prevent excessive cauterization by subsequent neutralization, may be objected to by those of us who have observed atresia following the application of this agent. Fibroids discovered during pregnancy call for palliative treatment wherever feasible. "In many instances the pregnancy is the only one the patient is to have; it is her only chance of securing a child. Everything possible, therefore, must be done to conserve the uterus during pregnancy; only if one is driven to operate should one do so." Of course, there may be cases where radical surgery represents true conservatism as, for instance, in certain cases of dysmenorrhœa in rudimentary or infantilistic uteri where no remedy avails and hysterectomy should be done. "This treatment may appear heroic, and naturally is only employed if the uterus is extremely small. But it is infinitely preferable to allowing such women weary years of suffering, with no possible prospect of relief until ovarian activity ceases." I may add, parenthetically, that nowadays radiotherapy would take the place of surgery.

I have given these quotations principally to illustrate the humane attitude of the author whose heart goes out to the patient and who, himself a master in surgical technique, yet espouses non-surgical methods wherever they seem to serve best the interests of the patient.

There is another point which is strongly emphasized in this book—the close and physiological relationship between gynecology and obstetrics, and the obvious disadvantage under which the pure gynecologist or the general surgeon labors who is not experienced in both these branches.

It is but natural that one dissents here and there from the author, but it is unnecessary to dwell on such more or less unimportant details. There is, however, one incorrect statement which should be modified in the next edition, namely, that spinal anæsthesia can not be employed if the patient is to be placed in the Trendelenburg position.

[1] Clinical and Operative Gynæcology. By J. M. Munro Kerr, M.B., C.M. London: Henry Frowde and Hodder & Stoughton, 1922.

The twelve full-sized colored plates are masterpieces of pictorial art. The numerous line drawings are less perfect. The illustrations of operative procedures will suffice for the operator with personal surgical experience; to the beginner they would be deficient in any complicated operation such as the Spinelli operation for inversion, the Wertheim technique in cervical cancer, or the Baldwin method for an artificial vagina. Despite its 832 pages, the book is not heavy, and the printing is excellent.

THE practitioner should, at the bed side, think in terms of pathological physiology. The necessary premise is a knowledge of the pathologico-anatomical changes which underlie all manifestations of disease. The physician will then be able properly to analyze the complaints of the patient, to recognize the connection between cause and effect, to arrive at the correct diagnosis, and to institute a rational treatment. This is the *Leitmotiv* of the small book in which Lahm has embodied his post-graduate lectures on gynecology at the well-known woman's clinic in Dresden.[1] The author covers the entire field of gynecological diseases by starting from the principal symptoms: discharge, bleeding, pain, amenorrhœa, and pressure signs due to mechanical factors. In each of these discussions the morbid alterations of the normal structures and the resulting changes of function are presented, which, in their turn, explain the outward manifestations. In by far the great majority of gynecological diseases, local causes can be found to account for the symptomatology. In some, for instance, in certain forms of discharge and in most of the instances of amenorrhœa, constitutional anomalies or disturbances of the general condition are at work. Pathological bleeding, unless caused by local sources such as polyp, submucous fibroid, carcinoma, or infectious processes, is due to dysfunction of the ovaries. Pain, in most instances, must be interpreted as the response of the central nervous system to local stimuli and will cease when the latter have been found and eliminated.

This analytical method of teaching is particularly appropriate in post-graduate instruction because it accurately reproduces the mode of approach in actual practice. Having used it myself in the class room for many years, I naturally find myself in full sympathy with the book and I feel that it deserves wide circulation. It will prove distinctly helpful to students and practitioners in the correlation of book learning and practical application; and it is full of valuable suggestions to teachers who are actively interested in the movement for more extended post-graduate instruction in this country.

TO the clinician who struggles through the maze of an ever increasing, and often contradictory, literature on endocrinological subjects, the book by Peritz[1] will appeal as a timely and reliable guide. The volume presents, in about 250 pages, a very clear exposition of the difficult matter and discloses, on the part of the author, not only a judicious consideration of the literature but also extensive personal experience. The chapter devoted to the sexual glands is almost twice as long as any of the chapters dealing with the other endocrine glands. This indicates that the author, who himself is a neurologist, fully realizes the all-important rôle the gonads play in the organism. In fact, it was from the sex glands that the teaching of endocrinology had its origin. It is of interest to read that 20 years before Brown-Séquard reported the startling observations made on himself after the injection of testicular extract, Berthold, of Goettingen, had performed autotransplantations of testicles in roosters and had, in his deductions, anticipated the achievements of the most recent times.

The gynecologist will find this chapter replete with valuable information. There are, for instance, the experiments of Steinach and Takakusu which prove the marked influence of ovarian hormones upon the entire organism and, in particular, on the central nervous system. The intricate subject of the determination of the sex is explained upon the basis of Mendel's laws and the discoveries by Henking and Wilson of the behavior of the chromatosomes in the germ cells. Variations and disturbances in the partitition and arrangement of these chromatosomes also offer an explanation, heretofore lacking, of certain malformations and developmental defects. A detailed discussion is devoted to the question of the interstitial gland. Peritz denies its existence in the human ovary and believes that in the species where these interstitial cells actually exist, they serve merely to store up and transmit the hormones produced by the follicle cells. (In this connection it is interesting to recall the recent studies by Doisy in the *Journal of the American Medical Association* which conclusively prove the follicle cells to be the source of the ovarian hormones.) Steinach's "rejuvenation" is explained by an increased absorption of sexual hormones and is only of very temporary benefit; it has no analogy in the female. Hermaphrodism, homosexualism, and infantilism have a very definite endocrine causation which is interestingly discussed.

A very illuminating chapter deals with the relation of constitution and internal secretion, and there again we meet with the decisive effect of the sexual hormones upon the central nervous system, the so-called erotization of the psyche. It may be accepted that men with a strongly developed sexuality are energetic, determined almost to the point of brutality, while the eunochoid shows a diametrically different behavior. That disturbances of the other endocrine glands influence directly or indirectly the sexual functions of the female organism—with which, for the moment, we are

[1] DIE PATHOLOGISCH-ANATOMISCHEN GRUNDLAGEN DER FRAUENKRANKHEITEN. By Prof. Dr. Wilhelm Lahm. Published by the Staatliche Frauenklinik, Dresden, 1922.

[1] EINFUEHRUNG IN DIE KLINIK DER INNEREN SEKRETION. By Prof. Dr. G. Peritz. Berlin: S. Karger, 1923.

mainly concerned—is repeatedly pointed out. As an example, the frequent occurrence of acromegalic signs in pregnancy may be cited.

These quotations may suffice to indicate the interesting qualities of the book. A further point of commendation is the clear distinction the author makes between facts (of which there are relatively few) and theories (of which there are many), and the practical applicability of these facts in the treatment of disease.

MEDICAL literature for nurses has been enriched decidedly by the appearance of two new books on obstetrical subjects. The book by Plass[1] reflects the attitude of Johns Hopkins and, in particular, the teachings of Williams. It is a complete treatise on obstetrics, quite comparable in outline and illustrations to any good textbook for medical students save that complicated and mooted questions have been condensed or omitted, and that the essentials of the knowledge of obstetrics have been put into as simple language as possible without the confusing detail. One feels entirely in sympathy with the author when he claims that nursing is constantly rising to a higher plane, and progressively more learning will be required of all in the profession; and we also agree with the author that the best educated nurse is one of the best mediums by which the public may be educated. So well has the author succeeded in his task that only favorable comments can be offered.

There is this fundamental difference between obstetrics and most of the other branches of medicine that we have to deal, in the majority of instances, with *normal* individuals whose health we wish to preserve. The object of obstetrics, therefore, is, in its last analysis, that of prophylaxis.

This purpose is even more apparent in the second book, which has emanated from the University of Oregon Medical School.[2] Moore presents to the nurse the present state of our knowledge concerning the nutrition of mother and child. Emphasis is placed on breast feeding, vitamins, and the mineral content of the diet, and only those procedures are described which have been tested and proven of practical value in personal experience. The sick child is only casually considered, as this volume is not intended to replace the physician in the home. "In all illnesses, acute or chronic, medical advice should be sought. The purpose of the book is to teach mothers how to render their families less subject to disease. As prevention is better than cure, our ideal should be the avoidance of unnecessary ills by proper diet from infancy." The greater part of the book, therefore, deals with the newborn child, both full term and premature, including his antenatal nutrition by means of the appropriate diet of the mother during pregnancy. There are, further, several chapters on diet and general hygiene for older children, which should prove highly interesting and instructive. A number of menus and recipes concludes the volume.

It is a pleasing thought that in far distant parts of our country forces are at work which make for the promotion of the welfare of mothers and children.

IF it is important to instruct nurses in the preventive aspect of obstetrics and obstetrical pediatrics, it is equally important to disseminate such knowledge among the laity. In a previous review[1] I have dwelt at length on the desirability of such steps and, for this reason, welcomed any new attractive books on these subjects. The best vehicle in this educational propaganda is, of course, books since they will reach where the spoken word and demonstrations can not penetrate. Whether it is possible, or even desirable, to combine instruction to nurses *and* mothers in *one* book, is, however, highly problematical. The *Nursery Guide for Mothers and Nurses*[2] by Sauer is a case in point. There is nothing whatever to be said against the tenor of the book which strives to impress the person in charge of an infant with her great responsibility. The advice given is perfectly sound and in conformity with the best medical standards. The two classes of readers, however, for whom the book is intended, require different treatment. What seems almost too brief for nurses, may be sufficient, if not superfluous, for mothers. To the latter, for example, the paragraph on blood examination with its reference to the normal white blood count and hæmoglobin determination, is bound to be unintelligible and, therefore, unnecessary. This and similar statements are minor defects compared with the introductory remarks where tuberculosis, syphilis, and gonorrhœa are discussed in three short paragraphs. These may, perhaps, mean something to the trained nurse who has had previous instruction in these diseases; to the mother they are merely terrifying. I would suggest that this first page be eliminated in any future edition.

IT is, probably, much more satisfactory to keep instruction of nurses and mothers separate, as has been done by Miss Van Blarcom. "To the Baby, upon whose wellbeing depends the future of the race"—thus the author inscribes very appropriately her guide for prospective mothers,[3] a companion book of her *Obstetrical Nursing* which was recently reviewed in these pages. I wish to call particular attention to this latest addition to the literature on popularized medicine. The two chapters on anatomy and physiology, and embryology, respectively (though these terms do not actually appear in print), are really masterpieces in their simplicity and are bound to convey to any

[1] Obstetrics for Nurses. By Everett Dudley Plass, M.D. New York and London: D. Appleton and Co., 1922.

[2] Nutrition of Mother and Child. By C. Ulysses Moore, M.D., M.Sc. Including Menus and Recipes by Myrtle Josephine Ferguson, B.S. Philadelphia and London: J. B. Lippincott Co., 1923.

[1] Surg., Gynec. & Obst., 1918, xxvii, 545.

[2] Nursery Guide for Mothers and Nurses. By Louis W. Sauer, M.A., M.D. St. Louis: C. V. Mosby Co., 1923.

[3] Getting Ready to be a Mother. By Carolyn Conant Van Blarcom, R.N. New York: The Macmillan Co., 1922.

woman of average intelligence some conception of her organs and of what is going on during the baby's intra-uterine existence. This newly acquired knowledge must also impress her with the realization that by taking care of herself she is also taking care of the baby, and thus make her eager to co-operate with the physician in his prenatal care. The chapters on the prenatal and postnatal care of mother and child are quite on a part with those mentioned and, like these, distinguished by a clarity and directness which leaves nothing unexplained. "If every expectant mother, no matter what her status or location, followed the simple, practical advice which this book offers, the rate of illness and death among our mothers and babies would be materially lessened." This is the statement made by J. C. Edgar and F. W. Rice in the introduction, and I heartily concur with their sentiments. The physician, I strongly feel, would do well to read this little book and to recommend its study to his patients.

OBSTETRICIANS are coming to realize that they can learn much from pediatrics, just as all of us have learned much from pathology. The pediatrician has, or should have, to deal with the obstetrician's results. This book by Hess[1] is of as vital importance to both specialties as are the recent works by Ehrenfest and von Reuss.

Obstetricians are prone to refer premature infants to pediatricians with greater alacrity than that with which they refer other babies. And pediatricians receive them with misgivings, not to say alarm. Both will welcome Hess' book as an authoritative, readable source of information on this particularly difficult and tricky variety of newborn. The material is not only admirably illustrated but also well arranged, making it readily accessible to "him who runs."

Part I discusses etiology, physiology, and pathology; Part II, the nursing and feeding care; Part III, the general diseases incident to prematurity; Part IV, the points influencing prognosis.

As special researches add to the accumulation of medical facts, books of this sort are bound to increase in number. And it is well that it should be so; for the specialist, instead of spending his substance on highly expensive "sets" and "systems," will be able to select his own library on his own specialty, thus minimizing his proportion of unread printed matter. P. J. WHITE.

[1] PREMATURE AND CONGENITALLY DISEASED INFANTS. By Julius H. Hess, M.D. Philadelphia and New York: Lea and Febiger, 1922.

BOOKS RECEIVED

Books received are acknowledged in this department, and such acknowledgment must be regarded as a sufficient return for the courtesy of the sender. Selections will be made for review in the interests of our readers and as space permits.

DISEASES OF THE RECTUM AND COLON AND THEIR SURGICAL TREATMENT. By J. Lockhart-Mummery, F.R.C.S. (Eng.), M.A., M.B., B.C., (Cantab.) New York: William Wood and Company, 1923.

THE HEART; ITS PHYSIOLOGY, PATHOLOGY, AND CLINICAL ASPECTS. By Dr. Selian Neuhof, B.S., M.D. Philadelphia: P. Blakiston's Son & Co., 1923.

SURGERY OF THE SPINE AND EXTREMITIES. By R. Tunstall Taylor, B.A., M.D., F.A.C.S. Philadelphia: P. Blakiston's Son & Company, 1923.

BIOLOGIE UND PATHOLOGIE DES WEIBES, EIN HANDBUCH DER FRAUENHEILKUNDE UND GEBURTSHILFE. By Josef Halban, and Ludwig Seitz. Berlin: Urban & Schwarzenberg, 1923.

PHYSICAL DIAGNOSIS. By Richard C. Cabot, M.D. 8th ed. New York: William Wood and Company, 1923.

L'INDIVIDUALITA DEL SANGUE NELLA BIOLOGIA, NELLA CLINICA E NELLA MEDICINA LEGALE. By Prof. Leone Lattes. Messina: Guiseppe Principato, 1923.

COLLECTED PAPERS OF THE MAYO CLINIC, ROCHESTER, MINNEAPOLIS. Edited by Mrs. M. H. Mellish, vol. xiv, 1922. Philadelphia and London: W. B. Saunders Co., 1923.

DIE METHODEN DER LOKALANAESTHESIE IN DER BAUCHCHIRURGIE UND IHRE ERFOLGE. By Prof. Dr. Hans Finsterer. Berlin: Urban & Schwarzenberg, 1923.

A TREATISE ON THE DISEASES AND INJURIES OF THE RECTUM, ANUS, AND PELVIC COLON. By J. Rawson Pennington, M.D., F.A.C.S. Philadelphia: P. Blakiston's Son & Co., 1923.

THE MEDICAL DEPARTMENT OF THE UNITED STATES ARMY IN THE WORLD WAR. Vol. I—The Surgeon General's Office. Prepared under the direction of Maj. Gen. W. M. Ireland, M.D., Surgeon General of the Army, by Col. Charles Lynch, M.C., Lt. Col. Frank W. Weed, M.C., and Loy McAfee, A.M., M.D. Washington: Government Printing Office, 1923.

AMERICAN COLLEGE OF SURGEONS

HOSPITAL STANDARDIZATION REPORT FOR 1923

INCLUDING LIST OF 1786 GENERAL HOSPITALS OF 50 OR MORE BEDS IN THE UNITED STATES AND CANADA WHICH MEET THE MINIMUM STANDARD OF THE COLLEGE

THE American College of Surgeons has just completed the sixth annual survey of hospitals in the United States and Canada. The results of this survey give evidence of steady progress toward hospital betterment and an increasing interest in the hospital standardization movement. Not only are the medical profession and the hospital people themselves vitally interested, but the public is developing a widespread belief in this effort for improved and highly efficient care of the sick.

Since the year 1918, when the American College of Surgeons first actively undertook the standardization of hospitals, there has gradually developed a new era in hospital service. This era is characterized by the development of more efficient institutions standing for the utilization of every means known to medical science for the best possible care of the patients. A definite standard has been established whereby hospitals may measure their efficiency in terms of service to the sick and end-results. The standard is now well beyond the experimental or trial stage. After six years of its application in large numbers of institutions on this continent, those charged with its promotion find no reason for altering any of the procedure laid down therein. This standard is based on a service so broad as to embrace the activities of every person who has anything whatsoever to do with the care of the patient—the hospital "perspective"—on whom the accumulative services of the institution must be focused. Every person in a hospital organization, no matter what their status may be, has a definite responsibility and share in the proper care of each individual patient and in the obtaining of the best possible result.

WHAT HOSPITAL STANDARDIZATION IS

Hospital standardization is an international movement including in its scope all general hospitals of fifty beds and over in the United States and Canada. It is carried on by the American College of Surgeons whose membership includes at present over 6000 surgeons in both countries as well as a number from South America. One of the outstanding features in the progressive program of the College is the movement for better hospital service, more widely known as hospital standardization. This movement, through the application of its inherent principles and by means of an annual survey, aims at establishing and maintaining in hospitals an organized personnel working as a group in the best interests of the patient. It demands that there be provided the necessary facilities for scientific diagnosis and treatment and that these facilities be utilized under competent direction. It requires that there be a careful and accurate recording of all data concerning each patient. This is necessary in order that there be a thorough study and investigation of each case to insure (a) an early, accurate, and comprehensive diagnosis, (b) the correct and effective treatment, (c) the best possible end-result. It is the desire of the College that, through the carrying out of this program, every individual requiring hospital treatment, regardless of race, color, creed, or social status, shall receive the benefits of the most up-to-date and scientific procedures known to modern medicine. This is a humanitarian service with the basic idea that our hospitals are conducted entirely for the benefit of the patient.

There is no desire to interfere with the individual initiative of any hospital. The standard set is the minimum requirement. Each institution is encouraged not only to reach that standard but go as far beyond it as possible. The requirements laid down are fundamental. They are the basic principles which are absolutely necessary to make the hospital a scientific institution, capable of rendering the best service to the patient, to the public, and to the profession.

The minimum standard sets forth certain clear cut and definite requirements which deal chiefly with the conduct of the hospital in the interest of the patient. These requirements may be briefly summarized as follows:

A. *The organization of the medical staff.* A hospital, meeting the minimum standard, must

have a competent and ethical medical staff to which certain duties are assigned as follows: (a) the drawing up of rules and regulations governing the professional work of the hospital, (b) the supervision of the professional activities of the hospital in order that the highest degree of efficiency may be maintained, (c) the carrying out of staff conferences at regular periods, and (d) the rendering of every assistance possible to the administration or management in the development and promotion of the professional work of the institution.

B. *The providing of case records.* In order to insure competent and satisfactory investigation and results in every case coming under treatment in a hospital, it is absolutely necessary that accurate records be provided. "A hospital without records is like a clock without hands, still running but providing no information to tell whether it is right or wrong." An accurate record is of inestimable value not only to the patient, the doctor, and the hospital, but also in the advancement of scientific medicine and research. Our hospitals owe to future generations records of present experiences. What we know of scientific medicine has largely been left to us by the masters of the past.

A physical accounting is required in every thoroughly competent hospital. Otherwise the institution is operating blindly without any definite realization as to its actual efficiency. This accounting can be carried out only when the findings, the facts, and conclusions on every case are properly recorded. Moreover, the record must have behind it the spirit of honesty and sincerity and be a filtration of scientific facts leading to a definite conclusion.

C. *The providing of diagnostic and therapeutic facilities.* In this regard special reference is made to the laboratory and X-ray services. Those departments, when efficiently organized and under competent direction, are of inestimable value, both in making a diagnosis and in carrying out treatment. The minimum standard does not only require that these facilities be available for the benefit of the patient in the hospital but that they be competently and scientifically utilized whenever required.

WHY HOSPITAL STANDARDIZATION COMMENCED

The American College of Surgeons was founded in 1913 with high ideals and certain professional requirements for Fellowship. Very early the surgeons found that their working environment in the hospitals was not in keeping with the ideals and objectives set forth by the College. Many hospitals at that time were lacking in a practical standard of efficiency. A careful consideration of the situation revealed the fact that the hospitals of the United States and Canada, generally speaking, lacked organization, satisfactory case records, and competent facilities to assist the doctors in carrying on their work. There was not satisfactory co-operation of the profession or the various groups working in the institution. Consultations were few and records incomplete. Any analysis or check-up of the work was lacking in most instances. Owing to these deficiencies candidates who were endeavoring to comply with the requirements for Fellowship in the College found it difficult, if not impossible, to provide satisfactory records of their cases. The College proceeded to gather information along definite lines with regard to the status of hospitals, and soon a large amount of valuable data was accumulated by means of correspondence with hospital officials, boards of trustees, and others, as well as by individual investigation on the part of College representatives. The information secured gave definite evidence of the existing hospital situation in the United States and Canada and was of great value to the College in formulating the program for better surgery.

The information collected was carefully considered and it was realized that there was a definite need for a sound and practical standard embodying certain fundamental principles which would provide the best possible hospital service, both from the standpoint of the patient and the physician. After careful deliberation the minimum standard was formulated—a standard which is minimum in name but maximum in effect, having a universal application and fitting all types of hospitals. This standard provides a fundamental service and procedure which any institution worthy of the name of hospital should accept. It is known as the minimum standard of the American College of Surgeons. This minimum standard is as follows:

THE MINIMUM STANDARD

1. That physicians and surgeons privileged to practice in the hospital be organized as a definite group or staff. Such organization has nothing to do with the question as to whether the hospital is "open" or "closed," nor need it affect the various existing types of staff organization. The word staff is here defined as the group of doctors who practice in the hospital inclusive of all groups such as the "regular staff," the "visiting staff," and the "associate staff."

2. That membership upon the staff be restricted to physicians and surgeons who are (a) competent in their respective fields and (b) worthy in character and in matters of professional ethics; that in this latter connection the practice of the division of fees, under any guise whatever, be prohibited.

3. That the staff initiate and, with the approval of the governing board of the hospital, adopt rules, regulations, and policies governing the professional work of the hospital; that these rules, regulations, and policies specifically provide: (a) That staff meetings be held at least once each month. (In large hospitals the departments may choose to meet separately.) (b) That the staff review and analyze at regular intervals the clinical experience of the staff in the various departments of the hospital, such as medicine, surgery, and obstetrics; the clinical records of patients, free and pay, to be the basis for such review and analysis.

4. That accurate and complete case records be written for all patients and filed in an accessible manner in the hospital, a complete case record being one, except in emergency, which includes the personal history, the physical examination, with clinical, pathological, and X-ray findings when indicated, the working diagnosis, the treatment, medical and surgical, the medical progress, the condition on discharge with final diagnosis, and, in case of death, the autopsy findings when available.

5. That clinical laboratory facilities be available for the study, diagnosis, and treatment of patients, these facilities to include at least chemical, bacteriological, serological, histological, radiographic, and fluoroscopic service in charge of trained technicians.

THE PRESENTATION OF THE PROGRAM OF HOSPITAL STANDARDIZATION TO THE HOSPITALS

Through the medium of the hospital visitor, hospital conferences held in various parts of the United States and Canada and widespread correspondence, the foundation of hospital standardization has been laid and the superstructure is now being well developed. The program of the American College of Surgeons is presented annually to all general hospitals of fifty beds and over in the United States and Canada. This is not done by correspondence but by personal visits of carefully selected investigators. These men are sent out from headquarters to visit the hospital by appointment and carefully survey the institution. They report their findings according to a definite and prescribed form laid down by the College. When possible they meet the various groups in conference, explaining the workings of the program and discussing such matters as pertain to the improvement of the service. The visitor reports to headquarters and a follow-up is maintained. The procedure, therefore, is to analyze through personal investigation the general hospitals of 50 beds and over in the United States and Canada, in terms of the minimum standard of service.

WHAT THE MINIMUM STANDARD REQUIRES

The minimum standard of the American College of Surgeons presents the following principles as essential to its attainment.

1. The doctors practicing in the hospital shall be organized as a staff. This organization may be carried out in either an "open" or a "closed" hospital. The staff should elect from time to time a chairman and secretary. Much of the success of the staff organization and staff meetings is dependent upon the efficiency of these two officers who must exercise good leadership and initiative.

2. The medical staff of the hospital shall be competent and ethical. The American College of Surgeons is absolutely opposed to the practice of "fee-splitting" in any manner whatsoever, and it is required that the staff of every hospital accepted under the minimum standard shall take a very definite stand in this regard.

3. The medical staff shall draw up rules and regulations for the guidance of the professional work in the hospital. By means of such rules and regulations the medical work of the institution is co-ordinated and systematized.

4. The medical staff shall hold conferences periodically, at least once every month, for analysis and review of the work carried on in the institution. At these conferences there should be a careful review of the medical work during the intervening period. It is advisable that a definite agenda be prepared for each meeting. This agenda should include consideration of the following: (a) the patients now resident in the hospital; (b) the patients discharged since the last staff meeting and the results of their treatment with special reference to the unimproved, infected, or complicated, and the deaths; and (c) everything pertaining to the betterment of the hospital service.

All discussion or criticisms at staff meetings should be of a constructive nature. A record of the proceedings should be kept by the secretary. The monthly analysis sheet has been found to be of great value in the staff conference.

5. There shall be a complete medical case record of every patient passing through the institution. There are certain fundamental requirements for a good case record system in any hospital. There is, first of all, the realization that the case record is a necessary part of the care and treatment of the patient. There must be the facilities for securing and filing of such records. The component parts should be carefully assembled and when complete form a comprehensive document setting forth the following information: identification data, complaints, personal and family history, history of the present illness, physical examination, consultations and special examinations, pre-operative or pre-treatment diagnosis, operation or treatment, final diagnosis, progress notes, condition on discharge and follow-up. Every record should be a comprehensive word picture of the patient, the illness, and other essential data. It should be an honest, sincere

record of facts and conclusions; otherwise it is of little value.

The securing and supervising of records is the responsibility of the physician. The filing of records is usually placed in the hands of a competent clerk. Various systems are utilized in hospitals. Whatever system is used these records should be readily accessible when required in the interest of the patient or the physician.

6. The hospital shall have an efficient laboratory and X-ray service. Both of these departments are absolutely essential for the carrying out of up-to-date diagnosis and treatment. They should be under the control of competent directors who may have technicians as their assistants. Unreliable laboratory or X-ray service is a serious detriment to any hospital and is decidedly dangerous. For the benefit of the surgical service and to promote good team work between the surgeon, the pathologist, and radiologist, it is advisable that these departments should be within easy access of the operating rooms. There are certain routine and fundamental tests or examinations which every laboratory and X-ray department should be equipped to carry on, and which may be immediately necessary at any time in any hospital. In standardized hospitals, routine pathological examination of all tissues is required in order that there may be a proper check-up on the work.

PROGRESS AND DEVELOPMENT OF THE MOVEMENT

During the past six years, hospitals of 100 beds and over in the United States and Canada have been carefully reviewed. Each year a list of hospitals meeting the minimum standard requirements is published and officially announced at the Clinical Congress of the American College of Surgeons. In addition, during the past two years, hospitals of 50 to 100 beds have been surveyed and those meeting the standard have also been added to the approved list. The progress and development of the movement today is well shown by the following figures taken from the list of approved hospitals between the years 1918 and 1923 inclusive.

100 Beds and Over

Year	Hospitals Surveyed	Hospitals Approved	Percentage
1918	692	89	12.9
1919	692	198	28.6
1920	692	407	58.8
1921	761	578	75.8
1922	812	677	83.4
1923	879	740	86.1

50 to 100 Beds

1922	812	335	41.3
1923	916	427	46.7

During 1923, 1786 hospitals were surveyed in the United States and Canada. Of these 1176, or 65.9 per cent, were approved as meeting the minimum standard.

These figures show conclusively that the medical, the hospital profession, and the public are profoundly interested in the program of hospital betterment. Without the support and co-operation of the above groups, the movement could not have succeeded.

REACTIONS TO HOSPITAL STANDARDIZATION

The hospital standardization movement, though still in its youth, has reached maturity in influence and development. It may justly be regarded as one of the greatest hospital movements known in history. The figures quoted show its magnitude and the enormous work associated with its development.

Four results of importance may be claimed for this program: (1) the shortening of the patient's days' stay in the hospital; (2) the preventing of any incompetent or unnecessary surgery; (3) the minimizing of the number of infections and complications; and (4) the lowering of the hospital death rate. In regard to the latter, it is very interesting to find that the average hospital death rate, which has been generally from 30, 40, and, in some instances, 50 per thousand patients treated, has been declining in certain institutions which have been operating strictly under the principles laid down by hospital standardization. Many instances show a falling of the death rate down to 30, 20, and even less per thousand patients.

These results have been accomplished through the sincere, honest, conscientious application of the principles as laid down by the College in the program for better hospitals. What a great thing it will be to industry if the days' stay of each industrial patient can be reduced 1 or 2 days in each illness. What a great comfort it will be to our people to know that they can go into certain hospitals where their illnesses will be more thoroughly studied and all data recorded, and through this an operation avoided or done under conditions surrounded with the maximum efficiency and safety. What a great thing to the world to find that the former average death rate per thousand patients can be reduced to 30, 20, or lower.

Possibly the greatest accomplishment to stimulate better results is the realization that there must be a physical accounting in our hospitals each month. Each institution should produce a physical balance sheet for the same reasons as there is a financial balance sheet. Both of these statements must be duly audited, the former by

NUMBER OF HOSPITALS MEETING THE MINIMUM STANDARD

United States and Canada	100 or more Beds			50 to 100 Beds			All Hospitals over 50 Beds		
	Number of Hospitals	Approved		Number of Hospitals	Approved		Number of Hospitals	Approved	
		Number	Percentage		Number	Percentage		Number	Percentage
Alabama	10	9	90	14	4	28.6	24	13	54.1
Arizona	2	1	50	2	0		4	1	25
Arkansas	5	4	80	10	9	90	15	13	86.7
California	47	34	72.3	29	6	20.7	76	40	52.6
Colorado	13	11	84.6	4	2	50	17	13	76.5
Connecticut	15	14	93.3	8	2	25	23	16	69.6
Delaware	2	2	100	1	0		3	2	66.7
District of Columbia	11	9	81.8	2	0		13	9	69.2
Florida	6	3	50	8	2	25	14	5	35.7
Georgia	12	9	75	17	8	47	29	17	58.6
Idaho	1	1	100	7	4	57.1	8	5	64.3
Illinois	62	42	67.7	61	21	34.4	123	63	51.2
Indiana	20	14	70	14	8	57.1	34	22	64.7
Iowa	14	12	85.7	27	15	55.6	41	27	65.9
Kansas	6	6	100	25	18	72	31	24	77.4
Kentucky	8	8	100	14	5	35.7	22	13	59.1
Louisiana	7	7	100	10	6	60	17	13	76.5
Maine	5	4	80	10	5	50	15	9	60
Maryland	15	14	93.3	11	6	54.5	26	20	76.9
Massachusetts	44	41	93.2	37	19	51.4	81	60	74.1
Michigan	25	25	100	20	9	45	45	34	75.6
Minnesota	27	27	100	20	9	45	47	36	76.6
Mississippi	5	3	60	8	2	25	13	5	38.5
Missouri	26	24	92.3	22	13	59.1	48	37	77.1
Montana	5	5	100	11	7	63.6	16	12	75
Nebraska	9	8	88.9	15	5	33	24	13	54.2
Nevada	0			2	2	100	2	2	100
New Hampshire	1	1	100	11	6	54.5	12	7	58.3
New Jersey	35	31	88.6	11	4	36.4	46	35	76.1
New Mexico	0			4	2	50	4	2	50
New York	120	105	87.5	72	35	48.6	192	140	72.9
North Carolina	5	4	80	21	11	52.4	26	15	57.6
North Dakota	5	5	100	7	2	28.6	12	7	58.3
Ohio	43	42	97.7	28	20	71.4	71	62	87.3
Oklahoma	2	2	100	12	2	16.7	14	4	28.6
Oregon	4	4	100	14	3	21.4	18	7	38.9
Pennsylvania	86	80	93	80	35	43.8	166	115	69.3
Rhode Island	3	3	100	3	2	66.7	6	5	83.3
South Carolina	5	5	100	11	4	36.4	16	9	56.3
South Dakota	4	3	75	12	10	83.3	16	13	81.3
Tennessee	10	9	90	12	7	58.3	22	16	72.7
Texas	21	16	76.2	22	9	40.9	43	25	58.1
Utah	5	5	100	1	1	100	6	6	100
Vermont	1	1	100	5	4	80	6	5	83.3
Virginia	7	6	85.7	28	12	42.9	35	18	51.4
Washington	16	15	93.8	18	4	22.2	34	19	55.9
West Virginia	6	6	100	23	7	30.4	29	13	44.8
Wisconsin	24	17	70.8	27	13	48.1	51	30	58.8
Wyoming	1			6	2	33.4	7	2	28.6
Totals for United States	806	697	86.5	837	382	45.6	1643	1079	65.7
Alberta	7	7	100	4	2	50	11	9	81.8
British Columbia	6	6	100	7	4	57.1	13	10	76.2
Manitoba	6	6	100	2	1	50	8	7	87.5
New Brunswick	1	1	100	9	8	88.9	10	9	90
Nova Scotia	3	3	100	8	8	100	11	11	100
Ontario	25	16	64	30	12	40	55	28	50.9
Prince Edward Island	0			3	3	100	3	3	100
Quebec	11	9	81.8	9	3	33.4	20	12	60
Saskatchewan	5	4	80	7	4	57.1	12	8	66.7
Totals for Canada	64	52	81.3	79	45	57.7	143	97	68.3
Grand Totals	870	749	86.1	916	427	46.7	1786	1176	65.9

the staff or medical auditors, and the second by the financial auditors, or so-called chartered accountants.

The effect of hospital standardization is more or less generally felt throughout the institution. The organization of the medical staff stimulates better organization throughout the hospital. A higher degree of ethics practiced among the attending doctors reacts beneficially on the nursing staff and internes. Through efficiency, accuracy, and thoroughness on the professional side of the institution, a decided influence along similar lines finds expression in the work of all the other groups. This program undoubtedly establishes an all around spirit of co-operation, rapidly embracing the various groups working in the institution. There is disseminated throughout the spirit of helpfulness, one to another, developing an increasing desire for more communalistic effort than formerly. In a hospital, particularly, we must remember that the various groups working therein cannot carry on without very intimate contact. There is in every hospital an ever present interdependence among the various individuals or groups working therein. There must be provision made for interchange and interaction. In order that there be established the best possible correlation of the various activities for the greatest benefit to the patient, there must be a very highly developed spirit of co-operation.

There is an added stimulus of clinical interest resulting in closer investigation of medical problems, and the advancement of scientific research. The regular staff conference is responsible in great measure for this stimulus. The staff conference brings the doctors together in a group, frequently breaking down local jealousies and always promoting a better spirit of working and consulting together.

Anything that tends to improve the professional atmosphere of the hospital cannot help but have a decided advantage and influence throughout. Therefore, we find that the program of hospital standardization today finds expression in a universal effect on the entire institution, establishing a higher ideal of service and producing a more profound professional consciousness, causing the three groups, namely, the governmental body, the doctors, and the hospital staff, all to work together better for the patient.

Outside of the hospital, the movement is a community interest. People today are seeking the standardized hospital when ill, for they know that the service therein is better administered and supervised. The governments, municipal bodies, and philanthropic organizations make use of the list of approved hospitals when responding to requests for financial assistance. Internes select the approved hospital when furthering their experience. Young women, desiring to take up nursing, also give preference to the approved hospital, knowing that such an institution is better organized and more efficient and can give a more thorough training. In certain instances, state and provincial governments have embodied the principles of hospital standardization in the clauses of their acts when formulating hospital legislation. This movement has been endorsed by a large number of allied organizations of the United States and Canada.

THE FUTURE OF HOSPITAL STANDARDIZATION

For a period of six years the minimum standard of the American College of Surgeons has been presented to the hospitals of this continent. The general principles of the movement have been well established, and it is now recognized that the important details and further development of the program may safely be undertaken.

There are in connection with the College several committees actively engaged in the study of certain problems relating not only to the various services in our hospitals but as well to the scientific treatment of certain types of patients. The beneficial results obtained from these investigations will be made available for hospitals and should be of inestimable value to them in their advancement.

From time to time requests for information on various subjects are being made to the College. So numerous have these become of late and such is the desire of the College to assist, that it has been found advisable to establish a bureau of information for hospitals. Through this a more extensive and continuous service can be given from headquarters.

The problem of the standardization of the smaller hospitals under 50 beds is being given careful consideration and its solution will be forthcoming in the near future.

Hospital standardization is but in its youth. It has now been proved to be an indispensable factor in increasing the efficiency of hospitals. This movement backed up by a more detailed service from the hospital department of the College will go on from year to year to a much greater attainment even than that which has been established at the present time. The future will, therefore, see a further development of the program and an increased interest and appreciation of the work as all groups directly or indirectly connected with the hospital service are fully convinced of its

value to the patient, the doctor, the hospital, and the entire community.

THE 1923 SURVEY

A complete list of approved hospitals from the 1923 survey follows. The work has increased considerably during the year, the magnitude of which can only be realized from the following considerations. There were nine hospital visitors engaged in the field who did sixty months (or five years) of survey work in 1923. The 1786 hospitals visited contained 237,946 beds caring for approximately 4,758,920 patients during the year. The estimated days' treatment for this group is 71,383,800. In the 1176 hospitals which have been accepted as approved there are 191,042 beds caring for approximately 3,820,840 patients with an estimated days' treatment of 57,312,600 for the year. During the survey work the visitors traveled approximately 75,000 miles. Follow-up letters from headquarters numbered over 3500. In addition to all this, 34 sectional meetings of the Clinical Congress of the American College of Surgeons were held in various parts of the United States and Canada. At each meeting, an interesting two-day program was provided. A considerable portion of this program on each occasion was devoted to hospital standardization. These meetings throughout were largely attended and fruitful of good results. All the above indicates the opportunity the hospital standardization movement has for extending its beneficial influence.

LIST OF HOSPITALS

The list which follows is complete up to October 22d of this year. The asterisk indicates that certain hospitals have accepted the requirements which result in the best scientific care of the patients but have not yet, for lack of time or other acceptable reasons, carried them out in every detail.

UNITED STATES

ALABAMA

100 or more beds

*Birmingham Baptist Hospital, Birmingham
Employees' Hospital, T. C. I. R. R. Co., Birmingham
Hillman Hospital, Birmingham
Mobile City Hospital, Mobile
*Moody Hospital, Dotham
Norwood Hospital, Birmingham
Providence Infirmary, Mobile
St. Vincent's Hospital, Birmingham
South Highlands Infirmary, Birmingham

50 to 100 beds

*Alabama Baptist Hospital, Selma
*Frasier Hospital, Dotham
John A. Andrew Memorial Hospital, Tuskegee
Vaughan Memorial Hospital, Selma

ARIZONA

100 or more beds

St. Joseph's Hospital, Phoenix

ARKANSAS

100 or more beds

Logan H. Roots City Memorial Hospital, Little Rock
St. Louis Southwestern R. R. Hospital, Texarkana
St. Vincent's Infirmary, Little Rock
Sparks Memorial Hospital, Fort Smith

50 to 100 beds

Baptist Hospital, Little Rock
*Davis Hospital, Pine Bluff
*Fayetteville City Hospital, Fayetteville
Leo N. Levi Memorial Hospital, Hot Springs
Michael Meager Memorial Hospital, Texarkana
St. Bernard's Hospital, Jonesboro
*St. John's Hospital, Fort Smith
*St. Joseph's Hospital, Hot Springs
St. Luke's Hospital and Annex, Little Rock

CALIFORNIA

100 or more beds

Alameda County Hospital, San Leandro
California Lutheran Hospital, Los Angeles
Children's Hospital, Los Angeles
*French Hospital, San Francisco
General Hospital, Fresno
Golden State Hospital, Los Angeles
Hospital for Children, San Francisco
Hospital of the Good Samaritan, Los Angeles
Loma Linda Sanitarium and Hospital, Loma Linda
Los Angeles General Hospital, Los Angeles
Mary's Help Hospital, San Francisco
Methodist Hospital, Los Angeles
Mt. Zion Hospital, San Francisco
*O'Connor Sanitarium, San Jose
Pasadena Hospital, Pasadena
Providence Hospital, Oakland
Sacramento Hospital, Sacramento
*St. Francis' Hospital, San Francisco
*St. Helen Sanitarium, Sanitarium
*St. Joseph's Hospital, San Francisco
St. Joseph's Hospital, San Diego
St. Mary's Hospital, San Francisco
St. Vincent's Hospital, Los Angeles
Samuel Merritt Hospital, Oakland
*San Diego County Hospital, San Diego
San Francisco Hospital, San Francisco
San Joaquin General Hospital, French Camp
Santa Barbara Cottage Hospital, Santa Barbara
Santa Clara County Hospital, San Jose
Seaside Hospital, Long Beach
Southern Pacific Hospital, San Francisco
Stanford University and Lane Hospitals, San Francisco
University of California Hospital, San Francisco
White Memorial Hospital, Los Angeles

50 to 100 beds

Clara Barton Hospital, Los Angeles
Mercy Hospital, Bakersfield
Murphy Memorial Hospital, Whittier
Orthopaedic Hospital, Los Angeles
*Paradise Valley Hospital, National City
*Ramona Hospital, San Bernardino

COLORADO

100 or more beds

Beth-El Hospital, Colorado Springs
*Boulder-Colorado Sanitarium, Boulder
Children's Hospital, Denver
Glockner General Hospital, Colorado Springs
Mercy Hospital, Denver
Minnequa Hospital, Pueblo
St. Anthony's Hospital, Denver
St. Francis' Hospital, Colorado Springs
St. Joseph's Hospital, Denver
St. Luke's Hospital, Denver
St. Mary's Hospital, Pueblo

50 to 100 beds

*Denver and Rio Grande Western R. R. Hospital, Salida
*Red Cross Hospital, Salida

CONNECTICUT

100 or more beds

Bridgeport Hospital, Bridgeport
Grace Hospital, New Haven
Greenwich General Hospital, Greenwich
Hartford Hospital, Hartford
*Hospital of St. Raphael, New Haven
Lawrence and Memorial Associated Hospitals, New London
*Meriden Hospital, Meriden
*Middlesex Hospital, Middletown
New Haven Hospital, New Haven
St. Francis' Hospital, Hartford
St. Mary's Hospital, Waterbury
St. Vincent's Hospital, Bridgeport
*Stamford Hospital, Stamford
Waterbury Hospital, Waterbury

50 to 100 beds

New Britain Hospital, New Britain
*Norwalk Hospital, Norwalk

DELAWARE

100 or more beds

*Delaware Hospital, Wilmington
*Homeopathic Hospital, Wilmington

DISTRICT OF COLUMBIA

100 or more beds

*Central Hospital and Dispensary, Washington
*Children's Hospital, Washington
Columbia Hospital for Women, Washington
Freedman's Hospital, Washington
Garfield Memorial Hospital, Washington
George Washington University Hospital, Washington
Georgetown University Hospital, Washington
Providence Hospital, Washington
*Washington Sanitarium and Hospital, Washington

FLORIDA

100 or more beds

Duval County Hospital, Jacksonville
*Miami City Hospital, Miami
St. Luke's Hospital, Jacksonville

50 to 100 beds

*Faith Hospital, St. Petersburg
Gordon Keller Memorial Hospital, Tampa

GEORGIA

100 or more beds

*Davis-Fischer Hospital, Atlanta
Georgia Baptist Hospital, Atlanta
Grady Memorial Hospital, Atlanta
Harbin Hospital, Rome
Piedmont Sanitarium, Atlanta
*St. Joseph's Hospital, Savannah
St. Joseph's Infirmary, Atlanta
University Hospital, Augusta
Wesley Memorial Hospital, Atlanta

50 to 100 beds

*Atlantic Coast Line Hospital, Waycross
*Downey Hospital, Gainesville
*Park View Sanitarium, Savannah
*Savannah Hospital, Savannah
Scottish Rite Hospital, Decatur
*Telfair Hospital, Savannah
*Thomasville City Hospital, Thomasville
Wise Sanitarium, Plains

IDAHO

100 or more beds

St. Alphonsus Hospital, Boise

50 to 100 beds

Pocatello General Hospital, Pocatello
*Providence Hospital, Wallace
*St. Anthony's Hospital, Pocatello
St. Luke's Hospital, Boise

ILLINOIS

100 or more beds

*Alexian Brothers' Hospital, Chicago
Augustana Hospital, Chicago
Chicago Lying-in Hospital, Chicago
Chicago Memorial Hospital, Chicago
Children's Memorial Hospital, Chicago
Columbus Hospital, Chicago
Cook County Hospital, Chicago
Evanston Hospital, Evanston
*Frances E. Willard Hospital, Chicago
*Grant Hospital, Chicago
*Hinsdale Sanitarium, Hinsdale
Hospital of St. Anthony de Padua, Chicago
Illinois Central Hospital, Chicago
Illinois Charitable Eye and Ear Infirmary, Chicago
*Lake View Hospital, Danville
Lutheran Deaconess Hospital, Chicago
*Lutheran Memorial Hospital, Chicago
Mercy Hospital, Chicago
Michael Reese Hospital, Chicago
Misericordia Hospital, Chicago
Mt. Sinai Hospital, Chicago

*Oak Park Hospital, Oak Park
Presbyterian Hospital, Chicago
Rockford Hospital, Rockford
St. Anne's Hospital, Chicago
St. Bernard's Hospital, Chicago
St. Elizabeth's Hospital, Chicago
*St. Elizabeth's Hospital, Danville
St. Francis' Hospital, Blue Island
St. Francis' Hospital, Evanston
St. Francis' Hospital, Peoria
St. Joseph's Hospital, Chicago
*St. Joseph's Hospital, Joliet
St. Luke's Hospital, Chicago
St. Mary's Hospital, East St. Louis
St. Mary's Infirmary, Cairo
*St. Mary's Hospital, Quincy
St. Mary of Nazareth Hospital, Chicago
South Shore Hospital, Chicago
Swedish Covenant Hospital, Chicago
University Hospital, Chicago
Wesley Memorial Hospital, Chicago

50 to 100 beds

*Blessing Hospital, Quincy
*Garfield Park Hospital, Chicago
Huber Memorial Hospital, Pana
Illinois Masonic Hospital, Chicago
*Kewanee Public Hospital, Kewanee
*Lake View Hospital, Chicago
*Lutheran Hospital, Moline
*Moline Public Hospital, Moline
North Chicago Hospital, Chicago
*Olney Sanitarium, Olney
Our Savior's Hospital, Jacksonville
Passavant Memorial Hospital, Jacksonville
*Post-Graduate Hospital, Chicago
*Provident Hospital, Chicago
Ravenswood Hospital, Chicago
St. Andrew's Hospital, Murphysboro
*St. Elizabeth's Hospital, Granite City
*St. Francis' Hospital, Freeport
*St. Francis' Hospital, Kewanee
St. Mary's Hospital, LaSalle
Washington Boulevard Hospital, Chicago

INDIANA

100 or more beds

Ft. Wayne Lutheran Hospital, Ft. Wayne
Gary Hospital, Gary
Indianapolis City Hospital, Indianapolis
*Methodist Episcopal Hospital, Indianapolis
*Protestant Deaconess Hospital, Evansville
Robert W. Long Hospital, Indianapolis
St. Anthony's Hospital, Terre Haute
*St. Edward's Hospital, New Albany
St. Elizabeth's Hospital, LaFayette
St. Joseph's Hospital, Ft. Wayne
St. Margaret's Hospital, Hammond
St. Mary's Hospital, Evansville
St. Mary's Mercy Hospital, Gary
*St. Vincent's Hospital, Indianapolis

50 to 100 beds

Epworth Hospital, South Bend
*Grant County Hospital, Marion
Muncie Home Hospital, Muncie
LaFayette Home and Hospital, LaFayette
Reid Memorial Hospital, Richmond
*St. Joseph's Hospital, Logansport
St. Joseph's Hospital, South Bend
Walker Hospital, Evansville

IOWA

100 or more beds

Finley Hospital, Dubuque
Iowa Lutheran Hospital, Des Moines
Iowa Methodist Hospital, Des Moines
Jennie Edmundson Hospital, Council Bluffs
Mercy Hospital, Cedar Rapids
Mercy Hospital, Council Bluffs
Mercy Hospital, Davenport
*Mercy Hospital, Des Moines
St. Joseph's Mercy Hospital, Dubuque
St. Joseph's Mercy Hospital, Sioux City
St. Vincent's Hospital, Sioux City
University Hospital, Iowa City

50 to 100 beds

*Des Moines City Hospital, Des Moines
Iowa Congregational Hospital, Des Moines
Iowa State College Hospital, Ames
Jane Lamb Memorial Hospital, Clinton
Lutheran Hospital, Hampton
Lutheran Hospital, Sioux City
New Samaritan Hospital, Sioux City
*Ottumwa Hospital, Ottumwa
Park Hospital, Mason City
St. Francis' Hospital, Waterloo
*St. Joseph's Hospital, Keokuk
St. Joseph's Hospital, Waverly
St. Joseph's Mercy Hospital, Clinton
St. Joseph's Mercy Hospital, Fort Dodge
St. Joseph's Mercy Hospital, Mason City

KANSAS

100 or more beds

Bethany Methodist Hospital, Kansas City
St. Francis' Hospital, Wichita
St. Margaret's Hospital, Kansas City
Santa Fe Hospital, Topeka
*Wesley Hospital, Wichita
*Wichita Hospital, Wichita

50 to 100 beds

Axtell Hospital, Newton
Bell Memorial Hospital, Kansas City
Bethel Deaconess Hospital, Newton
Halstead Hospital, Halstead
Hutchinson Methodist Hospital, Hutchinson
Jane C. Stormont Hospital, Topeka
*Mercy Hospital, Fort Scott
*Missouri, Kansas, and Texas R. R. Hospital, Parsons
*Mt. Carmel Hospital, Pittsburg
Providence Hospital, Kansas City
St. Anthony's Hospital, Hays
St. Anthony's Mercy Hospital, Sabetha
St. Elizabeth's Hospital, Hutchinson
St. Francis' Hospital, Topeka
St. John's Hospital, Salina
*St. Joseph's Hospital, Concordia
*St. Mary's Hospital, Winfield
St. Rose's Hospital, Great Bend

KENTUCKY

100 or more beds

Good Samaritan Hospital, Lexington
Louisville City Hospital, Louisville

Norton Memorial Hospital, Louisville
St. Anthony's Hospital, Louisville
*St. Elizabeth's Hospital, Covington
Sts. Elizabeth and Mary Hospital, Louisville
St. Joseph's Hospital, Lexington
St. Joseph's Infirmary, Louisville

50 to 100 beds

*Booth Memorial Hospital, Covington
Deaconess Hospital, Louisville
Illinois Central Hospital, Paducah
*Jewish Hospital, Louisville
*Wm. Mason Memorial Hospital, Murray

LOUISIANA

100 or more beds

Charity Hospital, New Orleans
*Charity Hospital, Shreveport
Hotel Dieu, New Orleans
*Presbyterian Hospital, New Orleans
St. Francis' Sanitarium, Munroe
T. E. Schumpert Memorial Hospital, Shreveport
Touro Infirmary, New Orleans

50 to 100 beds

Eye, Ear, Nose and Throat Hospital, New Orleans
*Flint-Goodridge Hospital, New Orleans
Illinois Central R. R. Hospital, New Orleans
North Louisiana Sanitarium, Shreveport
St. Patrick's Sanitarium, Lake Charles
Shriners' Hospital for Crippled Children, Shreveport

MAINE

100 or more beds

*Central Maine General Hospital, Lewiston
General Hospital of St. Marie, Lewiston
Eastern Maine General Hospital, Bangor
*Maine General Hospital, Portland

50 to 100 beds

*Augusta General Hospital, Augusta
Bath City Hospital, Bath
Children's Hospital, Portland
St. Barnabas Hospital, Portland
*State Street Hospital, Portland

MARYLAND

100 or more beds

Allegany Hospital, Cumberland
Bay View City Hospital, Baltimore
Church Home and Infirmary, Baltimore
Colonial Hospital, Baltimore
*Franklin Square Hospital, Baltimore
Hebrew Hospital and Asylum, Baltimore
Hospital for Women of Maryland, Baltimore
Johns Hopkins Hospital, Baltimore
Maryland General Hospital, Baltimore
Mercy Hospital, Baltimore
St. Agnes' Hospital, Baltimore
St. Joseph's Hospital, Baltimore
Union Hospital, Baltimore
University Hospital, Baltimore

50 to 100 beds

Children's Hospital School, Baltimore
Emergency Hospital, Easton
Frederick City Hospital, Frederick
James Lawrence Kerman Hospital, Baltimore
*South Baltimore General Hospital, Baltimore
*Western Maryland Hospital, Cumberland

MASSACHUSETTS

100 or more beds

Beverly Hospital, Beverly
Boston City Hospital, Boston
Brockton Hospital, Brockton
Burbank Hospital, Fitchburg
Cambridge City Hospital, Cambridge
Cambridge Hospital, Cambridge
Carney Hospital, Boston
Children's Hospital, Boston
City Hospital, Fall River
Cooley-Dickinson Hospital, Northampton
Free Hospital for Women, Boston
Gale Hospital, Haverhill
Henry Heywood Memorial Hospital, Gardner
Holyoke City Hospital, Holyoke
House of Mercy Hospital, Pittsfield
Lawrence General Hospital, Lawrence
Long Island Hospital, Boston
Lowell Corporation Hospital, Lowell
Lowell General Hospital, Lowell
Lynn Hospital, Lynn
*Malden Hospital, Malden
Massachusetts Charitable Eye and Ear Hospital, Boston
Massachusetts General Hospital, Boston
Massachusetts Homeopathic Hospital, Boston
Memorial Hospital, Worcester
Mercy Hospital, Springfield
New England Hospital for Women and Children, Boston
Newton Hospital, Newton Lower Falls
Noble Hospital, Westfield
Peter Bent Brigham Hospital, Boston
Providence Hospital, Holyoke
St. Elizabeth's Hospital, Boston
St. John's Hospital, Lowell
St. Luke's Hospital, New Bedford
St. Vincent's Hospital, Worcester
Salem Hospital, Salem
Springfield Hospital, Springfield
Union Hospital, Fall River
Waltham Hospital, Waltham
Wesson Memorial Hospital, Springfield
Worcester City Hospital, Worcester

50 to 100 beds

Beth Israel Hospital, Boston
Boston Lying-in Hospital, Boston
Charles Choate Memorial Hospital, Woburn
*Chelsea Memorial Hospital, Chelsea
City Hospital, Quincy
Clinton Hospital, Clinton
Farren Memorial Hospital, Montague City
Faulkner Hospital, Boston
Goddard Hospital, Brockton
Hart Private Hospital, Roxbury
House of the Good Samaritan, Boston
Infant's Hospital, Boston
*Josiah B. Thomas Hospital, Peabody
Melrose Hospital, Melrose
Morton Hospital, Taunton
North Adams Hospital, North Adams
Somerville Hospital, Somerville
Sturdy Memorial Hospital, Attleboro
Truesdale Hospital, Fall River

MICHIGAN

100 or more beds

Battle Creek Sanitarium, Battle Creek
Blodgett Memorial Hospital, Grand Rapids
Butterworth Hospital, Grand Rapids
Children's Free Hospital, Detroit
Detroit Receiving Hospital, Detroit
Evangelical Deaconess Hospital, Detroit
Grace Hospital, Detroit
Edward W. Sparrow Hospital, Lansing
Hackley Hospital, Muskegon
Harper Hospital, Detroit
Henry Ford Hospital, Detroit
Highland Park General Hospital, Highland Park
House of Providence, Detroit
*Hurley Hospital, Flint
Mercy Hospital, Bay City
*Mercy Hospital, Muskegon
New Borgess Hospital, Kalamazoo
Old Borgess Hospital, Kalamazoo
St. Joseph's Mercy Hospital, Ann Arbor
St. Mary's Hospital, Detroit
St. Mary's Hospital, Grand Rapids
*Saginaw General Hospital, Saginaw
University Hospital, Ann Arbor
W. A. Foote Memorial Hospital, Jackson
Woman's Hospital and Infants' Home, Detroit

50 to 100 beds

Bronson Methodist Hospital, Kalamazoo
Detroit Eye and Ear Hospital, Detroit
Memorial Hospital, Owosso
Mercy Hospital, Jackson
*Nichols Memorial Hospital, Battle Creek
*St. Francis' Hospital, Escanaba
St. Joseph's Hospital, Detroit
St. Joseph's Hospital, Hancock
St. Mary's Hospital, Saginaw

MINNESOTA

100 or more beds

*Abbott Hospital, Minneapolis
Ancker Hospital, St. Paul
Bethesda Hospital, St. Paul
Charles T. Miller Hospital, St. Paul
Colonial Hospital, Rochester
Deaconess Hospital, Minneapolis
Eitel Hospital, Minneapolis
Fairview Hospital, Minneapolis
Kahler Hospital, Rochester
Maternity Hospital, Minneapolis
Minneapolis General Hospital, Minneapolis
Minnesota State Hospital for Indigent Children, Minneapolis
Mounds Park Sanitarium, St. Paul
Northern Pacific Beneficial Association Hospital, St. Paul
Northwestern Hospital, Minneapolis
St. Barnabas Hospital, Minneapolis
St. John's Hospital, St. Paul
St. Joseph's Hospital, St. Paul
St. Luke's Hospital, Duluth
St. Luke's Hospital, St. Paul
St. Mary's Hospital, Minneapolis
St. Mary's Hospital, Duluth
St. Mary's Hospital, Rochester
St. Paul Hospital, St. Paul
Swedish Hospital, Minneapolis
University of Minnesota Hospital, Minneapolis
Worrell Hospital, Rochester

50 to 100 beds

Hill Crest Surgical Hospital, Minneapolis
*Immanuel Hospital, Mankato
*St. Gabriel's Hospital, Little Falls
*St. Joseph's Hospital, Brainerd
*St. Joseph's Hospital, Mankato
*St. Luke's Hospital, Fergus Falls
St. Raphael's Hospital, St. Cloud
Shriners' Hospital for Crippled Children, Minneapolis
*Warren General Hospital, Warren

MISSISSIPPI

100 or more beds

East Mississippi Charity Hospital, Meridian
*Mississippi State Charity Hospital, Jackson
South Mississippi Charity Hospital, Laurel

50 to 100 beds

King's Daughters' Hospital, Gulfport
Mississippi Baptist Hospital, Jackson

MISSOURI

100 or more beds

Alexian Brothers' Hospital, St. Louis
Barnes Hospital, St. Louis
Children's Mercy Hospital, Kansas City
Christian Church Hospital, Kansas City
Evangelical Deaconess Home and Hospital, St. Louis
Frisco Employees Hospital, St. Louis
*Grace Hospital, Kansas City
Jewish Hospital, St. Louis
Kansas City General Hospital, Kansas City
Lutheran Hospital, St. Louis
Missouri Baptist Sanitarium, St. Louis
Missouri Pacific R. R. Hospital, St. Louis
Old General Hospital, Kansas City
Research Hospital, Kansas City
St. Anthony's Hospital, St. Louis
St. John's Hospital, St. Louis
St. Joseph's Hospital, Kansas City
St. Louis Children's Hospital, St. Louis
St. Louis City Hospital, St. Louis
St. Louis Mullanphy Hospital, St. Louis
St. Luke's Hospital, Kansas City
St. Luke's Hospital, St. Louis
St. Mary's Hospital, Kansas City
St. Mary's Infirmary, St. Louis

50 to 100 beds

Baptist Hospital, St. Louis
Barnard Free Skin and Cancer Hospital, St. Louis
Bethesda Hospital, St. Louis
*Boone County Hospital, Columbus
Frisco Employees Hospital, Springfield
Independence Sanitarium, Independence
*Parker Memorial Hospital, Columbia
St. Francis' Hospital, Cape Girardeau
St. Francis' Hospital, Maryville
St. John's Hospital, Joplin
St. Mary's Hospital, Jefferson City
Trinity Lutheran Hospital, Kansas City
University Hospital, Kansas City

MONTANA

100 or more beds

Columbus Hospital, Great Falls
*Holy Rosary Hospital, Miles City

Montana Deaconess Hospital, Great Falls
Murray Hospital, Butte
St. James Hospital, Butte

50 to 100 beds

*Bozeman Deaconess Hospital, Bozeman
*Northern Pacific Beneficial Association Hospital, Glendive
Northern Pacific Beneficial Association Hospital, Missoula
St. Ann's Hospital, Anaconda
St. Joseph's Hospital, Lewiston
St. Patrick's Hospital, Missoula
St. Vincent's Hospital, Billings

NEBRASKA

100 or more beds

Bishop Clarkson Memorial Hospital, Omaha
Nebraska Methodist Episcopal Hospital and Deaconess Home, Omaha
*Nebraska Orthopedic Hospital and Home, Lincoln
St. Elizabeth's Hospital, Lincoln
St. Francis' Hospital, Grand Island
St. Joseph's Hospital, Omaha
St. Mary's Hospital, Columbus
University of Nebraska Hospital, Omaha

50 to 100 beds

Immanuel Hospital, Omaha
*Lincoln Hospital, Lincoln
*Presbyterian Hospital, Omaha
Swedish Mission Hospital, Omaha
Wise Memorial Hospital, Omaha

NEVADA

50 to 100 beds

Elko General Hospital, Elko
St. Mary's Hospital, Reno

NEW HAMPSHIRE

100 or more beds

St. Joseph's Hospital, Nashua

50 to 100 beds

Elliott Community Hospital, Keene
Elliott Hospital, Manchester
Hospital of Notre Dame, Manchester
Mary Hitchcock Memorial Hospital, Hanover
Nashua Memorial Hospital, Nashua
Sacred Heart Hospital, Manchester

NEW JERSEY

100 or more beds

Alexian Brothers' Hospital, Elizabeth
*Atlantic City Hospital, Atlantic City
Bayonne Hospital and Dispensary, Bayonne
Christ Hospital, Jersey City
*Cooper Hospital, Camden
Elizabeth General Hospital, Elizabeth
Engelwood Hospital, Engelwood
Hackensack Hospital, Hackensack
Hospital of St. Barnabas, Newark
Jersey City Hospital, Jersey City
*Mercer Hospital, Trenton
Monmouth Memorial Hospital, Long Branch
Morristown Memorial Hospital, Morristown
Mountainside Hospital, Montclair
Muhlenberg Hospital, Plainfield
Newark Beth Israel Hospital, Newark
Newark City Hospital, Newark
Newark Memorial Hospital, Newark
Orange Memorial Hospital, Newark
Passaic General Hospital, Passaic
Paterson General Hospital, Paterson
Perth Amboy City Hospital, Perth Amboy
*Presbyterian Hospital, Newark
St. Elizabeth's Hospital, Elizabeth
St. Francis' Hospital, Jersey City
St. Francis' Hospital, Trenton
St. James' Hospital, Newark
*St. Joseph's Hospital, Paterson
*St. Mary's Hospital, Hoboken
*St. Michael's Hospital, Newark
St. Peter's General Hospital, New Brunswick

50 to 100 beds

Ann May Memorial Hospital, Spring Lake
Homeopathic Hospital, Newark
*Middlesex General Hospital, New Brunswick
Nathan and Mariam Barnert Memorial Hospital, Paterson

NEW MEXICO

50 to 100 beds

*St. Joseph's Hospital, Albuquerque
*St. Mary's Hospital, Gallup

NEW YORK

100 or more beds

Albany Hospital, Albany
*Arnot-Ogden Memorial Hospital, Elmira
Auburn City Hospital, Auburn
Bellevue Hospital, New York
*Beth David Hospital, New York
Beth Israel Hospital, New York
Beth Moses Hospital, Brooklyn
Binghamton Hospital, Binghamton
Broad Street Hospital, New York
*Bronx Hospital, New York
Brooklyn Hospital, Brooklyn
Brownsville and East New York Hospital, Brooklyn
Buffalo City Hospital, Buffalo
Buffalo General Hospital, Buffalo
Buffalo Homeopathic Hospital, Buffalo
Buffalo Hospital of Sisters of Charity, Buffalo
Bushwick Hospital, Brooklyn
Carson C. Peck Memorial Hospital, Brooklyn
Children's Hospital, Buffalo
Columbus Extension Hospital, New York
Community Hospital, New York
Coney Island Hospital, Brooklyn
Cumberland Street Hospital, Brooklyn
Deaconess Home and Hospital, Buffalo
Ellis Hospital, Schenectady
Faxton Hospital, Utica
Fifth Avenue Hospital, New York
Flower Hospital, New York
Flushing Hospital and Dispensary, Flushing
Fordham Hospital, New York
French Benevolent Society Hospital, New York
Gouverneur Hospital, New York
Greenpoint Hospital, Brooklyn
Harlem Hospital, New York
Highland Hospital, Rochester
Holy Family Hospital, Brooklyn

Homeopathic Hospital, Albany
House of the Good Samaritan, Watertown
Hospital of the Good Shepherd, Syracuse
*Ithaca City Hospital, Ithaca
Jewish Hospital, Brooklyn
King's County Hospital, Brooklyn
Knickerbocker Hospital, New York
Lebanon Hospital, New York
Lenox Hill Hospital, New York
Lincoln Hospital, New York
Long Island College Hospital, Brooklyn
Manhattan Eye and Ear Hospital, New York
Memorial Hospital for Cancer and Allied Diseases, New York
Methodist Episcopal Hospital, Brooklyn
Metropolitan Hospital, New York
Misericordia Hospital, New York
Montefiore Hospital, New York
Mt. Sinai Hospital, New York
Mt. St. Mary's Hospital, Niagara Falls
Mt. Vernon Hospital, Mt. Vernon
New York City Hospital, Blackwell's Island, New York
*New York Eye and Ear Infirmary, New York
New York Foundling Home, New York
New York Hospital, New York
New York Infirmary for Women and Children, New York
New York Nursery and Children's Hospital, New York
New York Orthopedic Hospital, New York
New York Post-Graduate Hospital, New York
*New York Skin and Cancer Hospital, New York
New York Society for Relief of the Ruptured and Crippled, New York
*New York State Orthopedic Hospital for Children, West Haverstraw
Niagara Falls Memorial Hospital, Niagara Falls
Norwegian Lutheran Deaconess Hospital, Brooklyn
*Olean General Hospital, Olean
Oneida County Hospital, Rome
Park Avenue Clinical Hospital, Rochester
Presbyterian Hospital, New York
*Prospect Heights Hospital and Maternity, Brooklyn
Rochester General Hospital, Rochester
Rochester Homeopathic Hospital, Rochester
Roosevelt Hospital, New York
St. Catherine's Hospital, Brooklyn
*St. Elizabeth's Hospital and Home, Utica
St. Francis' Hospital, New York
St. John's Brooklyn Hospital, Brooklyn
St. John's Hospital, Long Island
St. John's Riverside Hospital, Yonkers
*St. Joseph's Hospital, Syracuse
St. Luke's Hospital, New York
*St. Luke's Hospital, Utica
St. Mark's Hospital, New York
St. Mary's Free Hospital for Children, New York
St. Mary's Hospital, Brooklyn
St. Mary's Hospital, Rochester
St. Peter's Hospital, Albany
St. Peter's Hospital, Brooklyn
St. Vincent's Hospital, New York
Samaritan Hospital, Troy
Sloane Hospital for Women, New York
*Soldiers and Sailors Memorial Hospital, Utica
Staten Island Hospital, Tompkinsville
Syracuse Memorial Hospital, Syracuse
The Sanitarium, Clifton Springs
Troy Hospital, Troy
*United Hospital, Port Chester
*United Israel Zion Hospital, Brooklyn
Women's Hospital, New York
Wyckoff Heights Hospital, Brooklyn
Yonker's Homeopathic Hospital and Maternity, Yonkers

50 to 100 beds

Amsterdam City Hospital, Amsterdam
Anthony Brady Hospital, Albany
Babies Hospital, New York
*Beekman Street Hospital, New York
*Broad Street Hospital, Oneida
*Brooks Memorial Hospital, Dunkirk
*Buffalo Columbus Hospital, Buffalo
*Champlain Valley Hospital, Plattsburg
Columbus Hospital, New York
Emergency Hospital of Sisters of Charity, Buffalo
General Hospital, Syracuse
Geneva City Hospital, Geneva
Glens Falls Hospital, Glens Falls
*Harbor Hospital, Brooklyn
Hudson City Hospital, Hudson
Jamaica Hospital, Jamaica
Jewish Maternity Hospital, New York
Kingston City Hospital, Kingston
Lawrence Hospital, Bronxville
*Leonard Hospital, Troy
Mary Immaculate Hospital, Jamaica
Mary McClelland Hospital, Cambridge
*Nassau Hospital, Mineola, Long Island
*Nathan Littauer Hospital, Gloversville
New Rochelle Hospital, New Rochelle
Ossining Hospital, Ossining
Peoples Hospital, New York
Reconstruction Hospital, New York
Rome Hospital, Rome
St. Bartholomew's Hospital, New York
*St. Joseph's Hospital, Yonkers
St. Vincent's Hospital, West New Brighton
Saratoga Hospital, Saratoga Springs
*Swedish Hospital, Brooklyn
*White Plains Hospital, White Plains

NORTH CAROLINA

100 or more beds

*James Walker Memorial Hospital, Wilmington
*North Carolina Baptist Hospital, Winston Salem
*St. Leo's Hospital, Greensboro
Watts Hospital, Durham

50 to 100 beds

Atlantic Coast Lines R. R. Hospital, Rocky Mount
Charlotte Sanitarium, Charlotte
City Hospital, Winston-Salem
Highpoint Hospital, Highpoint
Highsmith Hospital, Fayetteville
*Long's Sanitarium, Statesville
*Mercy Hospital, Charlotte
Parkview Hospital, Rocky Mount
*Rex Hospital, Raleigh
Rutherfordton Hospital, Rutherfordton
Salisbury Hospital, Salisbury

NORTH DAKOTA

100 or more beds

Bismarck Evangelical Deaconess Hospital, Bismarck
Grand Forks Deaconess Hospital, Grand Forks
St. Alexius' Hospital, Bismarck
St. John's Hospital, Fargo
St. Luke's Hospital, Fargo

50 to 100 beds

*St. Joseph's Hospital, Minot
St. Michael's Hospital, Grand Forks

OHIO

100 or more beds

Aultman Hospital, Canton
Bethesda Hospital, Cincinnati
Christ Hospital, Cincinnati
Cincinnati General Hospital, Cincinnati
City Hospital of Akron, Akron
Cleveland City Hospital, Cleveland
Glenville Hospital, Cleveland
Good Samaritan Hospital, Cincinnati
*Good Samaritan Hospital, Zanesville
Grant Hospital, Columbus
Hawkes Hospital of Mt. Carmel, Columbus
Huron Road Hospital, Cleveland
Jewish Hospital, Cincinnati
Lakeside Hospital, Cleveland
Lima Hospital, Lima
Lucas County Hospital, Toledo
*Lutheran Hospital, Cleveland
Mercy Hospital, Canton
Mercy Hospital, Hamilton
Mercy Hospital, Toledo
Miami Valley Hospital, Dayton
Mt. Sinai Hospital, Cleveland
*Peoples Hospital, Akron
St. Alexis' Hospital, Cleveland
St. Ann's Infant Asylum and Hospital, Cleveland
St. Elizabeth's Hospital, Dayton
St. Elizabeth's Hospital, Youngstown
St. Francis' Hospital, Columbus
St. John's Hospital, Cleveland
*St. Joseph's Hospital, Lorain
St. Luke's Hospital, Cleveland
St. Mary's Hospital, Cincinnati
St. Rita's Hospital, Lima
St. Vincent's Hospital, Cleveland
St. Vincent's Hospital, Toledo
*Seton Hospital, Cincinnati
Springfield City Hospital, Springfield
Toledo Hospital, Toledo
University Homeopathic Hospital, Columbus
*White Cross Hospital, Columbus
*Woman's Hospital, Cleveland
Youngstown Hospital, Youngstown

50 to 100 beds

Alliance City Hospital, Alliance
Bellaire City Hospital, Bellaire
*Bethesda Hospital, Zanesville
Children's Hospital, Cincinnati
Children's Hospital, Columbus
Deaconess Hospital, Cincinnati
Flower Hospital, Toledo
Good Samaritan Hospital, Sandusky
Lakewood Hospital, Lakewood
Mary Day Nursery and Children's Hospital, Akron
Massillon City Hospital, Massillon
Maternity and Children's Hospital, Toledo
Maternity Hospital, Cleveland
*Memorial Hospital, Fremont
Mercy Hospital, Columbus
Newark City Hospital, Newark
Robinwood Hospital, Toledo
Salem Hospital, Salem
Schirrman Hospital, Portsmouth
Warren City Hospital, Warren

OKLAHOMA

100 or more beds

St. Anthony's Hospital, Oklahoma City
State University Hospital, Oklahoma City

50 to 100 beds

*El Reno Sanitarium, El Reno
*Wesley Hospital, Oklahoma City

OREGON

100 or more beds

Emmanuel Hospital, Portland
Good Samaritan Hospital, Portland
Multnomah County Hospital, Portland
St. Vincent's Hospital, Portland

50 to 100 beds

Portland Sanitarium, Portland
Portland Surgical Hospital, Portland
*Sacred Heart Hospital, Medford

PENNSYLVANIA

100 or more beds

Abingdon Memorial Hospital, Abingdon
Allegheny General Hospital, Pittsburgh
Allentown Hospital, Allentown
Altoona Hospital, Altoona
Braddock General Hospital, Braddock
Chester County Hospital, West Chester
*Chester Hospital, Chester
Chestnut Hill Hospital, Philadelphia
Children's Homeopathic Hospital, Philadelphia
Children's Hospital, Pittsburgh
Clearfield Hospital, Clearfield
Columbia Hospital, Pittsburgh
Conemaugh Valley Memorial Hospital, Johnstown
Easton Hospital, Easton
Elizabeth Steel Magee Hospital, Pittsburgh
Frankford Hospital, Philadelphia
George F. Geisinger Hospital, Danville
Germantown Dispensary and Hospital, Philadelphia
Hahnemann Hospital, Scranton
Hahnemann Medical and Surgical Hospital, Philadelphia
Hamot Hospital, Erie
Harrisburg Hospital, Harrisburg
Homeopathic Medical and Surgical Hospital, Pittsburgh
Hospital of the Protestant Episcopal Church, Philadelphia
Hospital of the University of Pennsylvania, Philadelphia
Hospital of the Women's Medical College, Philadelphia
*J. Lewis Crozer Home and Hospital, Chester
Jefferson Hospital, Philadelphia
Jewish Hospital, Philadelphia
*Kane Summitt Hospital, Kane
Lancaster General Hospital, Lancaster
Lankenau Hospital, Philadelphia
*McKeesport Hospital, McKeesport
Medico Chirurgical Hospital, Philadelphia
Memorial Hospital, Roxborough
Mercy Hospital, Johnstown
Mercy Hospital, Philadelphia
Mercy Hospital, Pittsburgh
Mercy Hospital, Wilkes-Barre
Methodist Episcopal Hospital, Philadelphia

Misericordia Hospital, Philadelphia
Moses Taylor Hospital, Scranton
Mt. Sinai Hospital, Philadelphia
Passavant Hospital, Pittsburgh
Pennsylvania Hospital, Philadelphia
Philadelphia General Hospital, Philadelphia
Philadelphia Polyclinic Hospital, Philadelphia
Pittsburgh Hospital, Pittsburgh
Pottsville Hospital, Pottsville
Presbyterian Hospital, Philadelphia
Presbyterian Hospital, Pittsburgh
Reading Hospital, Reading
Robert Packer Hospital, Sayre
Sacred Heart Hospital, Allentown
St. Agnes' Hospital, Philadelphia
St. Francis' Hospital, Pittsburgh
St. John's General Hospital, Pittsburgh
St. Joseph's Hospital, Lancaster
*St. Joseph's Hospital, Philadelphia
St. Joseph's Hospital, Pittsburgh
St. Joseph's Hospital, Reading
St. Luke's Hospital, South Bethlehem
St. Margaret's Hospital, Pittsburgh
St. Mary's Hospital, Philadelphia
St. Vincent's Hospital, Erie
Samaritan Hospital, Philadelphia
South Side Hospital, Pittsburgh
State Hospital for Injured Persons, Ashland
State Hospital of Middle Coal Fields, Hazelton
State Hospital of Northern Anthracite Region of Pennsylvania, Scranton
Uniontown Hospital, Uniontown
Washington Hospital, Washington
West Philadelphia Hospital for Women, Philadelphia
Western Pennsylvania Hospital, Pittsburgh
Wilkes-Barre City Hospital, Wilkes-Barre
*Williamsport Hospital, Williamsport
Wills Hospital, Philadelphia
Women's Homeopathic Hospital, Philadelphia
Women's Hospital, Philadelphia
York Hospital and Dispensary, York

50 to 100 beds

Annie M. Warner Hospital, Gettysburg
Bainbridge Private Hospital, Philadelphia
Bryn Mawr Hospital, Bryn Mawr
Carlisle Hospital, Carlisle
Children's Hospital, Philadelphia
Children's Hospital of Mary J. Drexel Home, Philadelphia
Citizens General Hospital, New Kensington
*Columbia Hospital, Columbia
Cottage State Hospital, Blossburg
*DuBois Hospital, DuBois
Good Samaritan Hospital, Lebanon
Howard Hospital, Philadelphia
*Homeopathic Hospital, West Chester
Indiana Hospital, Indiana
J. C. Blair Memorial Hospital, Huntington
*Jewish Maternity Hospital, Philadelphia
Kensington Hospital for Women, Philadelphia
Maple Avenue Hospital, DuBois
*Memorial Hospital of Monongahela, Monongahela
*Montefiore Hospital, Pittsburgh
*Ohio Valley Hospital, McKees Rock
Oil City Hospital, Oil City
Palmerton Hospital, Palmerton
Philadelphia Lying-in Charity Hospital, Philadelphia
*Pittston Hospital, Pittston
*Polyclinic Hospital, Harrisburg
Preston Retreat Hospital, Philadelphia
*Providence Hospital, Beaver Falls
St. Luke's Homeopathic Hospital, Philadelphia
St. Vincent's Hospital for Women and Children, Philadelphia
*Sewickley Hospital, Sewickley
*State Hospital of Nanticoke, Nanticoke
*Stetson Hospital, Philadelphia
Suburban General Hospital, Bellevue
Windber Hospital, Windber

RHODE ISLAND

100 or more beds

Newport Hospital, Newport
Rhode Island Hospital, Providence
St. Joseph's Hospital, Providence

50 to 100 beds

Memorial Hospital, Pawtucket
Providence Lying-in Hospital, Providence

SOUTH CAROLINA

100 or more beds

Columbia Hospital, Columbia
Florence Infirmary, Florence
Greenville City Hospital, Greenville
Roper Hospital, Charleston
South Carolina Baptist Hospital, Columbia

50 to 100 beds

Anderson County Hospital, Anderson
Baker Sanatorium, Charleston
St. Francis Xavier Infirmary, Charleston
*University Hospital, Anderson

SOUTH DAKOTA

100 or more beds

McKennan Hospital, Sioux Falls
*Sacred Heart Hospital, Yankton
St. Luke's Hospital, Aberdeen

50 to 100 beds

Bartron Hospital, Watertown
Lincoln Hospital, Aberdeen
Luther Hospital, Watertown
*Moe Hospital, Sioux Falls
New Madison Hospital, Madison
Methodist State Hospital, Mitchell
*Peabody Hospital, Webster
*St. Joseph's Hospital, Deadwood
*St. Joseph's Hospital, Mitchell
St. Mary's Hospital, Pierre

TENNESSEE

100 or more beds

Baptist Hospital, Memphis
Erlanger Hospital, Chattanooga
George W. Hubbard Hospital, Nashville
Knoxville General Hospital, Knoxville
Memphis General Hospital, Memphis
Nashville City Hospital, Nashville
St. Joseph's Hospital, Memphis
St. Thomas Hospital, Nashville
Vanderbilt Hospital, Nashville

50 to 100 beds

Baird-Dulaney Hospital, Dyersburg
*Fort Sanders Hospital, Knoxville
Lucy Brinkley Hospital, Memphis
Newell and Newell Sanitarium, Chattanooga
*Protestant Hospital, Nashville
*Riverside Hospital, Knoxville
Woman's Hospital of State of Tennessee, Nashville

TEXAS

100 or more beds

Baptist Hospital, Houston
Baylor Hospital, Dallas
Central Texas Baptist Sanitarium, Waco
Hotel Dieu, Beaumont
John Sealy Hospital, Galveston
Parkland Hospital, Dallas
Providence Hospital, Waco
St. Joseph's Infirmary, Ft. Worth
St. Joseph's Infirmary, Houston
St. Mary's Infirmary, Galveston
St. Paul's Sanitarium, Dallas
Santa Fe Hospital, Temple
Santa Rosa Infirmary, San Antonio
Scott and White Sanitarium, Temple
Seton Infirmary, Austin
Southern Pacific Hospital, Houston

50 to 100 beds

All Saints' Hospital, Ft. Worth
*City and County Hospital, Houston
*Frances Ann Lutcher Hospital, Orange
Harris Sanitarium, Ft. Worth
International and Great Northern R. R. Hospital, Palestine
King's Daughters' Hospital, Temple
*Masonic Hospital, El Paso
*St. Joseph's Infirmary, Paris
*Texarkana Sanitarium, Texarkana

UTAH

100 or more beds

Doctor W. H. Groves Latter Day Saints' Hospital, Salt Lake City
Holy Cross Hospital, Salt Lake City
St. Mark's Hospital, Salt Lake City
Salt Lake County Hospital, Salt Lake City
Thomas D. Dee Memorial Hospital, Ogden

50 to 100 beds

Utah-Idaho Hospital, Logan

VERMONT

100 or more beds

Mary Fletcher Hospital, Burlington

50 to 100 beds

Fanny Allen Hospital, Winooski
Heaton Hospital, Montpelier
Rutland Hospital, Rutland
*St. Albans Hospital, St. Albans

VIRGINIA

100 or more beds

Chesapeake and Ohio R. R. Hospital, Clifton Forge
†Hospital Division of Medical College of Virginia, Richmond
Norfolk Protestant Hospital, Norfolk
St. Vincent's Hospital, Norfolk
Stuart Circle Hospital, Richmond
University of Virginia Hospital, Charlottesville

50 to 100 beds

Elizabeth Buxton Hospital, Newport News
George Ben Johnson Memorial Hospital, Abington
*Grace Hospital, Richmond
Jefferson Hospital, Roanoke
Johnston-Willis Sanitarium, Richmond
King's Daughters' Hospital, Staunton
Lake View Hospital, Suffolk
Lewis Gale Hospital, Roanoke
*Parrish Memorial Hospital, Portsmouth
St. Elizabeth's Hospital, Richmond
St. Luke's Hospital, Richmond
Sarah Leigh Hospital, Norfolk

WASHINGTON

100 or more beds

Children's Orthopedic Hospital, Seattle
Columbus Sanitarium, Seattle
King County Hospital, Seattle
Maria Beard Deaconess Hospital, Spokane
*Northern Pacific Hospital, Tacoma
Providence Hospital, Seattle
Sacred Heart Hospital, Spokane
St. Elizabeth's Hospital, Yakima
St. Joseph's Hospital, Tacoma
St. Luke's Hospital, Spokane
St. Mary's Hospital, Walla Walla
Seattle City Hospital, Seattle
Seattle General Hospital, Seattle
Swedish Hospital, Seattle
Tacoma General Hospital, Tacoma

50 to 100 beds

Minor Private Hospital, Seattle
*St. Joseph's Hospital, Bellingham
St. Luke's Hospital, Seattle
Virginia Mason Hospital, Seattle

WEST VIRGINIA

100 or more beds

Charleston General Hospital, Charleston
Kessler Hatfield Hospital, Huntington
Ohio Valley Hospital, Wheeling
St. Mary's Hospital, Clarksburg
Welch Hospital, No. 1, Welch
Wheeling Hospital, Wheeling

50 to 100 beds

*Beckley Hospital, Beckley
Bluefield Sanitarium, Bluefield
Coal Valley Hospital, Montgomery
Cook Hospital, Fairmont
Davis Memorial Hospital, Elkins
Guthrie Hospital, Huntington
McKendree Hospital, No. 2, McKendree

WISCONSIN

100 or more beds

LaCrosse Lutheran Hospital, LaCrosse
Luther Hospital, Eau Claire
Madison General Hospital, Madison
Mercy Hospital, Janesville
Milwaukee County Hospital, Milwaukee

Milwaukee Hospital, Milwaukee
Mt. Sinai Hospital, Milwaukee
St. Agnes' Hospital, Fond du Lac
St. Elizabeth's Hospital, Appleton
St. Francis Hospital, LaCrosse
St. Joseph's Hospital, Marshfield
St. Joseph's Hospital, Milwaukee
*St. Mary's Hospital, Green Bay
St. Mary's and Mercy Hospital, Oshkosh
St. Mary's Hospital, Milwaukee
St. Mary's Hospital, Superior
Trinity Hospital, Milwaukee

50 to 100 beds

*Columbia Hospital, Milwaukee
Evangelical Deaconess Hospital, Milwaukee
Grandview Hospital, LaCrosse
*Hanover General Hospital, Milwaukee
*Holy Family Hospital, Manitowoc
*LaCrosse Public Hospital, LaCrosse
Milwaukee Children's Hospital, Milwaukee
*Milwaukee Maternity and General Hospital, Milwaukee
Misericordia Hospital, Milwaukee
St. Joseph's Hospital, Dodgeville
*St. Luke's Hospital, Racine
St. Mary's Hospital, Madison
St. Mary's Hospital, Racine

WYOMING

50 to 100 beds

*Casper Private Hospital, Casper
Wheatland Hospital, Wheatland

CANADA

ALBERTA

100 or more beds

General Hospital, Calgary
Edmonton General Hospital, Edmonton
Holy Cross Hospital, Calgary
Medicine Hat Hospital, Medicine Hat
Misericordia Hospital, Edmonton
Royal Alexandra Hospital, Edmonton
University of Alberta Hospital, Edmonton

50 to 100 beds

Lamont Public Hospital, Lamont
*Galt Hospital, Lethbridge

BRITISH COLUMBIA

100 or more beds

Provincial Royal Jubilee Hospital, Victoria
Royal Columbian Hospital, New Westminster
Royal Inland Hospital, Kamloops
St. Joseph's Hospital, Victoria
St. Paul's Hospital, Vancouver
Vancouver General Hospital, Vancouver

50 to 100 beds

*Queen Victoria Hospital, Revelstoke
*St. Eugene Hospital, Cranbrook
*St. Mary's Hospital, New Westminister
*Vernon Jubilee Hospital, Vernon

MANITOBA

100 or more beds

Brandon General Hospital, Brandon
Children's Hospital, Winnipeg
Grace Hospital, Winnipeg
Misericordia Hospital, Winnipeg
St. Boniface's Hospital, St. Boniface
Winnipeg General Hospital, Winnipeg

50 to 100 beds

Victoria Hospital, Winnipeg

NEW BRUNSWICK

100 or more beds

General Public Hospital St. John

50 to 100 beds

Chipman Memorial Hospital, St. Stephen
Hotel Dieu, Campbellton
Hotel Dieu, Chatham
Miramichi Hospital, New Castle
Moncton Hospital, Moncton
St. John's Infirmary, St. John
Restigouche and Bay of Chaleur Soldiers' Memorial Hospital, Campbellton
*Victoria Public Hospital, Fredericton

NOVA SCOTIA

100 or more beds

St. Joseph's Hospital, Glace Bay
Salvation Army Hospital, Halifax
Victoria General Hospital, Halifax

50 to 100 beds

*Aberdeen Hospital, New Glasgow
Children's Hospital, Halifax
General Hospital, Glace Bay
Halifax Infirmary, Halifax
Highland View Hospital, Amherst
St. Martha's Hospital, Antigonish
*Sydney City Hospital Sydney
*Yarmouth Hospital, Yarmouth

ONTARIO

100 or more beds

General Hospital, Kingston
Grace Hospital, Toronto
Hamilton General Hospital, Hamilton
Hotel Dieu, Kingston
McKellar General Hospital, Ft. William
Ottawa General Hospital, Ottawa
Protestant General Hospital, Ottawa
St. Joseph's Hospital, Hamilton
*St. Joseph's Hospital, London
St. Joseph's Hospftal, Sudbury
St. Luke's Hospital, Ottawa
St. Michael's Hospital, Toronto
Sick Children's Hospital, Toronto
Toronto General Hospital, Toronto
Western Hospital, Toronto
Victoria Hospital, London

50 to 100 beds

*General Hospital, Brockville
General Hospital, Sault Ste. Marie

Nicholls Hospital, Peterboro
Oshawa Memorial Hospital, Oshawa
*Owen Sound General and Marine Hospital, Owen Sound
*Public Hospital, Smith Falls
*St. Francis' Hospital, Smith Falls
St. Joseph's Hospital, Peterboro
St. Vincent de Paul Hospital, Brockville
Welland County Hospital, Welland
Wellesley Hospital, Toronto
Women's College Hospital, Toronto

PRINCE EDWARD ISLAND

50 to 100 beds

Charlottetown Hospital, Charlottetown
*Prince County Hospital, Summerside
Prince Edward Island Hospital, Charlottetown

QUEBEC

100 or more beds

Children's Memorial Hospital, Montreal
General St. Vincent Hospital, Sherbrooke
Hotel Dieu, Montreal
Jeffery Hale's Hospital, Quebec
Montreal General Hospital, Montreal
Notre Dame Hospital, Montreal
Sainte Justine Pour Les Enfants, Montreal
Royal Victoria Hospital, Montreal
Western Hospital, Montreal

50 to 100 beds

Montreal Maternity Hospital, Montreal
St. Francois d'Assise, Quebec
*Sherbrooke Hospital, Sherbrooke

SASKATCHEWAN

100 or more beds

Grey Nuns Hospital, Regina
Providence Hospital, Moose Jaw
St. Paul's Hospital, Saskatoon
*Saskatoon City Hospital, Saskatoon

50 to 100 beds

Holy Family Hospital, Prince Albert
Notre Dame Hospital, North Battleford
*Moose Jaw General Hospital, Moose Jaw
*Victoria Hospital, Prince Albert

SURGERY, GYNECOLOGY AND OBSTETRICS

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PEDICULATED POLYPOID FIBRO-ADENOMA OF THE STOMACH OF BALL-VALVE TYPE, CAUSING AN UNUSUAL AND COMPLEX SYNDROME

PERIODIC CRISES OF INTENSE EPIGASTRIC PAIN, WITH SHOCK, VOMITING, MELÆNA (TARRY STOOLS) AND PROFOUND SECONDARY ANÆMIA; TRANSFUSION; COMPLETE RELIEF AND RECOVERY FOLLOWING EXTIRPATION OF TUMOR BY GASTROTOMY; A CLINICAL REPORT, WITH DISCUSSION [1]

BY RUDOLPH MATAS, M.D., F.A.C.S., NEW ORLEANS

Professor of Surgery, Tulane University of Louisiana School of Medicine

CLINICAL history.[2] Mr. W. F. M., age 55, farmer, native of Mississippi, has resided in the country all his life. There is nothing in his heredity or in his personal history of any importance as related to his present condition. He has always been a hard-working farmer, enjoying excellent health and well able to keep up with any of the men in the field.

His present trouble began rather suddenly, 16 months ago. He had worked hard on a very hot day and perspired freely. "He relaxed after the day's work was over and took no precaution against taking cold." The next morning he felt pain in the chest, especially in the left costal margin, on breathing. He paid no serious attention to the pain at the time, but the pain became so much worse that a doctor had to be summoned, who told him that he had pleurisy. He had some fever at that time. In a few days he was well and went back to work. While in the field, 2 weeks later, he suddenly fainted. He was taken home and remained in bed for 4 days, growing weaker daily and losing his appetite gradually. At the end of 4 days he "picked up" and began to recover. The following week saw him out on the farm again. Some weeks later a third attack came. This time he had violent pain in the epigastrium, followed by complete collapse. Again he became profoundly weak, lost his appetite, and had slight temperature and excessive perspiration at night. He was treated this time for pulmonary tuberculosis. He recovered after a time sufficiently to work again on the farm, when a fourth attack came in the form of a sudden and sharp pain in the pit of the stomach, with nausea and vomiting. During this spell he had a number of loose stools of a tar-like color. He was then advised to have a roentgen-ray examination. In the interim between this attack and his admission to the infirmary he had several of these "up-and-down spells," each one coming closer, lasting longer, and disabling him more than the preceding one. *During an attack he was always seized by an acute violent pain in the epigastrium, accompanied by shock and a sense of persistent depression, faintness, pallor, with nausea and vomiting of gastric contents (no blood), followed soon after by the passage of dark, tarry stools. The attacks were of variable duration and intensity, and lasted from a few minutes to a few hours.* These spells would cease spontaneously, but more often required morphine and other sedatives to quiet him. After the crises, he would pick up, gain strength, look better and feel inclined to work, but each succeeding attack left a deeper impression on his strength and a greater pallor. The pain in the epigastrium was an invariable accompaniment of an attack. Nausea, vomiting, and loose, tarry stools were not always present.

By the advice of his physician he came to New Orleans and consulted Dr. John B. Elliott, who admitted him to the Touro Infirmary on January 11, 1922. After careful examination and repeated radiographic sittings, he concluded that the patient had an ulcer at the pylorus, whether or not malig-

[2] Abridged from the records of Touro Infirmary, by Dr. J. Cohen, interne.

[1] Read in abstract at the meeting of the Southern Surgical Association, Memphis, Tennessee, December, 1922

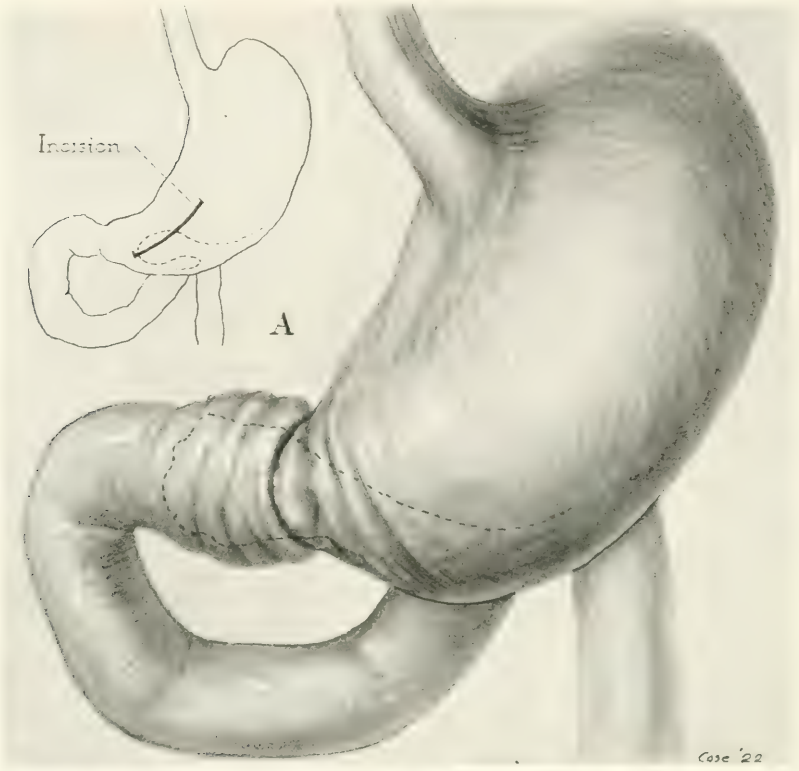

Fig. 1. Pedunculated polypoid fibro-adenoma of the stomach. Insert, *A*, shows the normal position of the growth in the quiescent stage; the larger drawing, *B*, the growth impacted in the pylorus and upper duodenum, causing invagination of the stomach into the duodenum, (Matas.)

nant he could not tell, but advised that the patient be operated upon promptly "as the only chance he had for his life." He returned home on his discharge from the infirmary on January 13, 1922. Having had another severe attack in the meantime, he returned to the hospital on January 17, 1922, and applied to Dr. Matas for surgical relief.

Condition on admission, January 17, 1922. The picture of a tall, powerful man, 6 feet 2 inches, normally weighing 185 pounds, now a physical wreck from the effects of malnutrition, emaciation, and pain; he is strikingly anæmic and totters from weakness. The lips and tongue are dry and the skin warm; the teeth are neglected and the breath foul. Except for the persistent weakness and loss of flesh, with the complaint of a gnawing pain localized in the epigastrium and radiating to the back, the physical examination of the patient is largely negative. The abdomen is retracted, scaphoidal, and no tumor can be palpated in the epigastrium or anywhere in the abdomen. The attacks of pain that he complains of have no relation to the time of eating, quality, or quantity, of food. They come independently of the meals. On admission the pulse is 100; blood pressure: systolic 124, diastolic 58; pulse pressure 66; temperature 100 degrees. The urine showed a trace of albumin with a few granular and hyaline casts. Blood: total red count 1,762,000; hæmoglobin 30 per cent; color index 88; total white count 4050; differential: small 20; large 4; neutrophiles 75; eosinophiles 1; anisocytosis; poikilocytosis. The gastric analysis showed a hyperchlorhydria, *no blood*. The fæces show occult blood in every examination. The radiographic laboratory (January 13, 1922), among other less important details, reports: "There is a marked deformity about the pylorus and stomach. A serial radiographic examination following the second barium meal showed a large filling defect about the pylorus, probably due to an extensive ulcer of beginning malignancy. The stomach emptied readily and is empty entirely at the end of 6 hours. Conclusions: *Saddle ulcer, probably malignant.*" (See roentgenograms.)

In the light of the operative findings it is easier to interpret the roentgenograms of the pylorus, but, even with all of the knowledge obtained through the operation, it is evident that the correct diagnosis could not have been made by the roentgenogram alone.

The patient was admitted in a period of calm. He then could eat and drink with seeming impunity, but, he had no appetite. However, in order to prepare him for the operation, he was put on a milk diet, with eggs, gelatin, and thin cereals, at regular intervals, and a Murphy drip instituted, containing glucose 5 per cent, panopepton, calcium chloride, and gelatin to counteract the hæmorrhages. Digalen (minims 10) with morphine (1/8 gr.) and atropine were given by needle nightly.

Transfusion. January 19, on the third day after admission, 400 cubic centimeters of citrated blood obtained from the patient's son were transfused by Dr. Lucian H. Landry. No immediate notable effect followed except a febrile reaction, 101 degrees F., the next day, and continued with remissions to the third day after transfusion. There has always been an underlying febrile movement since his admission, with a daily variation of 1 degree above and below the normal line. The blood pressure rose 20 points and the blood picture improved only a little. The benefit from this transfusion appears to have been transitory. The absence of pain and vomiting and tarry stools seems to have improved the patient. On January 20, 3 days after admission, the patient was brought to the operating room, only to be sent back after careful deliberation with the anæsthetist, Dr. Caine, as too great a risk and unfit to undergo any serious operation. The diastolic blood pressure then was barely 58 and the hæmoglobin a little over 30 per cent.

Again systematic feeding was resumed and a daily record of blood pressure and of the character of stools was kept. For 2 weeks this was continued, although the blood pressure scarcely arose over 65 diastolic, and the hæmoglobin to 45 per cent. Nevertheless, the freedom from pain and apparent cessation of intestinal hæmorrhage contributed to the improvement of the patient. As he improved, he became restless and impatient for operation.

Operation. (Notes dictated by Dr. Matas.) This was performed, February 3, 1922, 16 days after the patient's admission to the infirmary. Under gas-oxygen anæsthesia (Dr. Caine) the abdomen was opened by epigastric incision, right rectus, a little to the right of the mid line. The exploring hand of the operator at once palpated the pylorus, which was thickened and enlarged, giving the impression that it was the seat of a neoplasm which involved the whole pyloric contour on the gastric and duodenal sides of the pyloric ring. A mass seemed to block the pyloric ring and project into the duodenum. *While attempting to exteriorize the pylorus for further inspection, the manipulations dislodged the mass "en bloc," and, to our surprise, this retreated completely within the stomach, leaving the pyloric ring free but without the slightest evidence of infiltration or thickening of any sort.* It seemed then that there was a foreign body of soft consistency, the nature of which we could not determine, but which, by blocking the pylorus, acted as a ball valve, accounting in this way, at least, for the periodicity of the attacks.

Fig. 2. Appearance of tumor on opening the stomach after it had retracted from the pylorus (semidiagrammatic). Drawing should show the duodenum more dilated. *A*, Sketch of tumor with part of attached pedicle. (Matas.)

Taking every precaution to prevent the spilling of the gastric contents, and in order to control the movements of the mass (which had migrated far up in the gastric cavity, requiring considerable manipulation to recover and hold it in place), the stomach was clamped above and below the tumor with a pair of thin Doyen forceps. After the stomach had been exteriorized above the level of the pyloric antrum it was opened right over the mass, immediately above the pyloric antrum, by an incision, 2 inches in length, running parallel with the long axis of the stomach and lying midway between the lesser and greater curvature (Fig. 1). Through this incision the mass was recognized as a pediculated gastric tumor, which, as previously stated, was attached to and grew from the mucosa on a level with the greater curvature and about 5 to 6 inches above the pylorus. The tumor had an attachment to the mucous membrane about 3 centimeters in width at its base, tapering into a narrow neck about 1 centimeter in width at its attachment to the tumor. The tumor was therefore extremely movable, but it projected into

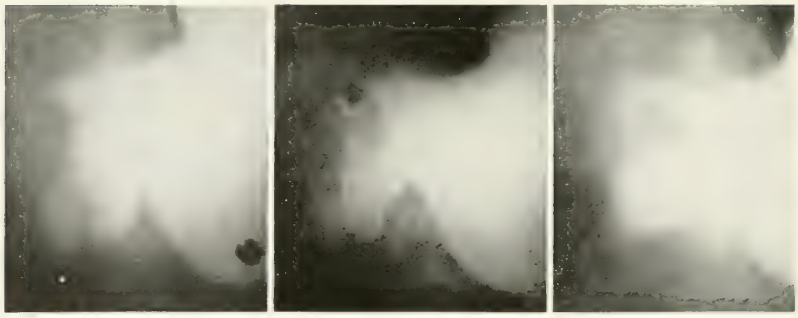

Fig. 3. Case of W. F. M. Polypoid pediculated adenoma of the stomach of the ball-valve type. Series of roentgenograms taken immediately after the ingestion of the opaque meal. They show a large and striking filling defect in the pylorus and duodenum which is dilated at the pyloric junction and thrown into folds by the invagination of the tumor with its attached pedicle. The exposures were made during the period of calm, in the interval between the gastric crises, caused by pylorospasm with strangulation of the tumor and of the invaginated gastric mucosa. (Reproduced by courtesy of the Roentgenologic Laboratory of the Touro Infirmary.)

the interior of the stomach like a mushroom (Figs. 1 and 2), without ulceration, fungosity, or any raw surface whatever. It was merely a growth from the mucosa which rested on a mobile base, freely movable, on the submucous and muscular layers. In consequence of the mobility of its base of attachment the tumor can be easily exteriorized through the incision and its base clamped and crushed with a Payr angiotribe. After this the mass was amputated and the raw surface left on the mucosa was sutured over with continuous silk. This completed the hæmostasis and sealed the raw surface left by the excision of the tumor. The incision into the stomach wall was also closed with continuous silk suture for the mucosa and double Lembert for the peritoneum and muscular coats. Before closing, the stomach, pylorus, and first part of the duodenum were again palpated and inspected from within, but no signs of ulceration could be detected, only a marked dilatation of the first part of the duodenum, which could be accounted for by the presence of the tumor, which acted not only as a ball valve, blocking the pylorus, but was probably accompanied by an intussusception of the gastric mucosa into the duodenum as the stomach tried vainly to squeeze and rid itself of the tumor. Before closing the abdomen the gall bladder was palpated and found to be perfectly normal, free from calculi and emptying readily on pressure. It was also noticed in replacing the stomach and great omentum that there were several enlarged lymph nodes on the gastro-epiploic arch. Nothing further was done except to close the abdominal incision in the usual way, with deep interrupted separate silkworm sutures and the rest of the wound was closed in tiers, with catgut. The specimen was immediately transferred to the pathologist, Dr. Lanford, whose report is appended.

A Jutte duodenal tube was left in the stomach, projecting through the nose for the purpose of draining the gastric contents which might accumulate in the stomach by regurgitation from the duodenum through a widely dilated pylorus, and, also, to act as a flue or ventilator to allow the continued escape of gases.

The recovery of the patient was uneventful in spite of his weakened condition, and when discharged, February 22, 1922, the abdominal wound was completely healed. On the day before his departure the urine still showed a faint trace of albumin but no casts; the stools were negative for occult blood; the blood pressure, 132–88; the total red cell count was 2,585,000; hæmoglobin 45 per cent; color index 0.9; total white cells 5150; differential: small 8; large 3; neutrophiles 89; anisocytosis; poikilocytosis less marked.[1]

Pathologist's report. "The specimen is a mushroom-shaped structure with edges somewhat irregular. In its longest diameter it measures 6 centimeters and other measurements in the same plane are 4.5 and 2 centimeters. At its widest portion it measures 5 centimeters and its thickness varies from 1.5 to 2 centimeters. The upper surface is somewhat uneven but velvety in consistency, and of a pinkish-yellow color, relatively uniform throughout. The under surface is of the same general appearance, except that the attached mucosa is relatively loose and gives an impression of being stretched and pediculated by the growth. The under surface also presents a relatively large raw area, in the central portion of which is a firm, fibrous mass or pedicle. The consistency is firm, with the density of the gastric mucosa, but it is uniform throughout. On section it offers little resistance to the knife and presents a cut surface resembling the cut surface of the gastric mucosa, that is, a thick layer of pinkish-gray color, soft and supported by a denser tissue of connective-tissue type. In the upper layer, which is relatively

[1] It is now 1 year and 6 months (June 1, 1923) since this patient was operated upon, and his reports up to the present time confirm his complete recovery. He has continued to work on his farm without interruption or sign of relapse.

uniform, are noted a few minute spaces filled with mucous material. Gross diagnosis is mucous polypus.

"*Diagnosis.* Adenoma. Histologically benign. Section shows glandular acini of various sizes and shapes, some of which are filled and to a degree distended with fluid. The epithelium is for the most part high columnar and adult in type. The stroma is largely smooth muscle."

This observation is instructive in many ways, but its chief interest lies in its diagnostic teachings. Here we have a clear-cut, well-defined, symptomatic picture and a clinical history which, together with the roentgenologic findings, leads to almost certain pre-operative conclusions, yet, nevertheless, contradicted by the operative findings. Here we learn that a perfectly benign polypoid or pediculated non-vascular tumor may cause paroxysmal gastric crises characterized by the most intense epigastric pain with vomiting and extreme exhaustion verging on actual collapse. That these crises are accompanied and followed by black, tarry stools (melæna), which by frequent repetition led to a progressive and profound secondary anæmia, reaching a low hæmoglobin ebb of 30 per cent, and a red cell count of less than 1,750,000. In addition, the radiologic image as seen in series through the screen, and by radiograph, distinctly suggest the presence of a tumor which fills the pylorus, causing obstruction and pylorospasm. While the roentgenograms, when looked at in the light of the operative findings, are susceptible of a different interpretation than that which was suggested by the pre-operative image, the presumption that the filling defect in the pylorus and duodenum was caused by a malignant growth seemed *then* to be in harmony with the general conclusions arrived at by the clinician.

With such a syndrome and clinical history before us, it is not surprising that a correct pre-operative diagnosis should have been missed in this, as in nearly all the cases of this type, thus far reported, in spite of the roentgenological examination. Is it surprising that, in the vast majority, the diagnosis of malignant tumor or ulcer of the pylorus, with spasm, saddle ulcer, or duodenal ulcer, should have been the predicated diagnosis? Or, again, when there is no occult blood in the fæces nor melanotic stools, the acute paroxysmal pain in the epigastrium should have been interpreted often as a gall-stone colic, the real cause—a benign pediculated and mobile tumor prolapsed into the duodenum—only coming to light in the course of the exploration? This then is the usual error—the classic error—which has been constantly repeated until very recent times.

On the other hand, the pain, vomiting, and pyloric obstruction (filling defect revealed by the roentgen-rays), and the periodicity of these gastric crises followed by periods of calm, during which there were practically no digestive disturbances, are all signs and symptoms which, when looked at *a posteriori*, are strikingly suggestive of a mobile, intermittent pathology not in consonance with the continuously progressive history of gastric carcinoma. A different interpretation of the roentgenographs and of the symptomatology in this case would, no doubt, have been suggested if only the clinical behavior of the polypoid or pediculated benign tumors of the stomach had been more clearly impressed on the minds of the several observers, and the differential diagnosis had not been influenced by the estimate of probabilities in favor of malignant tumor. We can readily understand the mechanism by which these periodic crises are produced by the traction exercised on the extensible base of the tumor after it has been ejected through the pylorus into the duodenum. Similar cases which exhibit the sequence of pyloric obstruction, strangulation, and invagination of the gastric mucosa have already appeared in the literature and are strikingly illustrated in the observations reported by Chiari (6), 1888 (quoted by Ledderhose); Lotsch (16); Wade (23); Bland-Sutton (4); and more recently by Baylac and Dieulafé (3) (invagination in non-pediculated gastric tumors), in which the real pathology was only brought to light by the operative findings.

But the presence of blood in the fæces and the black, tarry stools, sufficient to cause a profound secondary anæmia, as in this case, is not so easily accounted for by the presence of a simple benign polypus and is truly confusing to the clinician. A cursory survey of the recent and growing literature of polypoid adeno-

mata in particular and of the benign tumors of the stomach in general (of which the pediculated tumors form a very considerable part) shows that bleeding, sufficient to cause a severe anæmia—though rarely as grave as in this case—is a frequent accompaniment of these growths whether they be of an intrinsically vascular type (hæmangiomata, myoma) or non-vascular (fibroma, fibromyoma, or adenoma type). Thus, in a recent study of 27 benign tumors of the stomach observed and operated upon at the Mayo Clinic, according to Eusterman and Senty (7), recurrent intestinal hæmorrhage was observed as a notable complication in fully 37 per cent of the cases. These observers account for these hæmorrhages chiefly by ulceration or erosion of a part of the tumor. But in the present instance the tumor was free from ulceration, erosion, or varicosities of any kind. In fact, the tumor showed relatively little vascularity. Even admitting a temporary intussusception of the mucosa of the stomach with partial strangulation during the attacks, it is difficult to conceive of such profuse oozing as to cause tarry stools (which brought about a state of collapse at the end of each one of the gastric crises) as the result of mere obstructive congestion and strangulation without ulceration.

Of the benign pediculated tumors of the stomach the myomata are notoriously most liable to progressive hæmorrhage, behaving in this respect somewhat like the polypoid myomata of the uterus or the submucous fibromyomata of this organ. The gravity of the gastrorrhagias from this source is well shown by Farr and Glenn (8), who in writing of the myomata of the stomach report a case terminating fatally by hæmorrhage. That the intestinal hæmorrhages were caused in our case by the presence of the tumor (a simple fibro-adenoma) cannot be doubted, since the bleeding was completely and permanenty arrested with the cessation of the crises after the tumor was removed.

The repeated attacks of pain, the hæmorrhages, exhaustion, occurring at frequent intervals, and loss of weight, continued to direct the attention of the clinician to the more common and vastly more frequent occurrence of malignant disease of the stomach as the more probable diagnosis. This probability was seemingly confirmed by the roentgenologic findings, and all these facts combined tended to deviate the observer's thoughts from the rare benign tumors, whether pediculated or sessile, which are coupled only in a vague hypothetic way with such grave manifestations as were displayed in this case. *It is the failure to realize that a benign and especially a pediculated tumor in the stomach may assume a very malignant aspect ending in death—that is largely responsible for the little attention that is given to these tumors in scanning the differential diagnosis.* The fact that benign tumors of the stomach are statistically rare as compared with the malignant have made them a negligible factor in the estimate of probabilities in cases clouded with obscure or contradictory evidence. Eusterman and Senty, previously quoted, reported a total of 27 benign tumors of the stomach observed in the Mayo Clinic between 1907 and 1921. "During this period operation had been performed on 2,146 patients with cancer of the stomach, on 20 with sarcoma, and on 2 with malignant polypus of the stomach, a total of 2,168. The proportion, therefore, of malignant new-growths to benign new-growths is 78 to 1, i.e., 1.3 per cent of all gastric tumors are benign. But this proportion in our experience is only relative, for, during the same period, 2,285 additional cases of malignant gastric neoplasms, the majority of them inoperable, passed through the clinic." The actua' proportion of benign new-growths to the malignant new-growths or ulcerations they estimate to be 1 to 200.

While the relative infrequency of the benign tumors of the stomach shown by these and other statistics is fully recognized, the surgeon should not be too hasty in attributing to cancer all the manifestations of the advanced gastropathies in which intermittent or periodic epigastric pain, tumor, vomiting, intestinal hæmorrhage, and anæmia, with radiologic evidence of pyloric stenosis and spasm, play a prominent part.

In all cases a thorough sifting of the clinical evidence, especially the occurrence of gastric crises at periodic intervals, after which the stomach enters into a stage of calm, should suggest a most careful and repeated study of

the roentgenologic image with the view of differentiating the polypoid or pediculated tumors which offer more distinctive characteristics and are more frequently benign and operable. That a *pre-operative* diagnosis of these polypoid or other benign growths, especially if pediculated, is possible with the aid of the improved roentgen-ray technique of the present day, is shown by the case reports and contributions of Myer (18; 1913), Stoner (22; 1914), and Basch (2; 1916), Carman (5; 1918), Balfour (1; 1919), and Eusterman and Senty (7; 1922) of the Mayo Clinic; Holmes (12; 1919) of Detroit (pediculated malignant growths); Pendergrass and Pancoast (20; 1920); Ruggles (21; 1920); Merrill (17; 1921), and others in this country. Differential pre-operative diagnoses based on the radiological evidence are reported in the foreign literature by Heinz (11; 1911), Konjetzny (13; 1919–1920), Geymueller (10; 1919), Gassmann (9; 1921), Lieblein (15; 1921), Paus (19; 1908), of Christiania, Ledderhose (14; 1913), and others. While these observers have recorded diagnoses that were more tentative than positive, they are in several instances stated by the roentgenologist independently and in opposition to the clinical diagnosis, showing that in each instance there were reasons derived from the appearance of the roentgenograms to justify a doubt as to the diagnosis of malignant disease in favor of a benign tumor, especially when these were polypoid or pediculated. Gassmann, who has recently (1921) written more specifically upon the roentgen diagnosis of gastric polypi, states that "the fact that a pediculated polypus of the stomach can be diagnosed radiologically is not without practical significance. In some cases operation for carcinoma of the stomach prolongs life, but in the majority of instances it shortens it. If the case which he (Gassmann) reports had been diagnosed as carcinoma he would have hesitated to operate. When it was decided that the growth was probably a polypus it was clear that an operation was necessary to prevent death from bleeding." The operative findings confirmed the roentgen-ray diagnosis and the patient recovered. Eusterman and Senty are right when they state: "Often patients with benign gastric tumors are refused operation because the condition is regarded as malignant and inoperable. The true nature of the lesion is only discovered when the patients insist on operation." *The one salient fact that comes out of this discussion and that is to be retained by the surgeon in approaching a surgical gastropathy is that the most perfect clinical picture of cancer of the stomach may be imitated even to a fatal issue by a perfectly operable benign growth.*

The low mortality and excellent surgical end-results obtained by extirpation of benign polypoid tumors, which are reported by nearly all observers, would justify at least an exploration in doubtful cases, even in the seemingly desperate and forbidding circumstances related in this case.

SUPPLEMENTARY ADDENDUM

The term "polypoid adenoma" is applied in this observation in a qualifying sense to mean simply a pedunculated tumor. Pediculation or pedunculation is an anatomical peculiarity which is common to many tumors. In the gastro-intestinal tract, this mode of attachment may be exhibited by nearly all the benign tumors, such as the lipomata, fibromata, myomata, fibromyomata, lymphangiomata, hæmangiomata, etc., and also, but rarely, by the malignant tumors which may grow on a primarily benign pediculated tumor or develop secondary mobile attachments. At one time, before the histological differentiation of tumors had made as much progress as it has today, all pendulous tumors attached to, or hanging from, mucous surfaces were described as mucous polypi; but at present the term is restricted to the pediculated tumors of a specific histological type, namely, the *adenomata*, when the growth imitates the glandular epithelium of the gastric mucosa, and to the *papillomata*, or mucous warts, which imitates and reproduces the normal surface epithelium.

In this instance we are using the term polypoid in a broad, generic sense to indicate a benign, movable tumor attached by a stem, stalk, or movable base to the surface of the gastro-intestinal mucosa. I lay stress on this point, as I believe that the pediculation of a tumor of the stomach gives it a distinctive clinical and diagnostic physiognomy which

differentiates the polypoid or pediculated tumors as a class, from the sessile or non-pediculated growths which are more often malignant.

When gastric tumors are pediculated they are mobile and the range of excursion varies with the length of the pedicle and the mobility of the base of attachment, some pedicles measuring only a few millimeters and others 12 centimeters or more in length. The base of attachment is also movable according to the nature of the growth and of the surface to which it is attached; the attached mucosa may slide freely on its submucous and muscular layers, yielding readily to traction and thus increasing the length of the pedicle to a very great extent, as in this instance and in many other cases. In some instances the whole wall of the stomach may be dimpled, inverted, or invaginated at the point of attachment of the pedicle, provided sufficient traction is exercised by the tumor. It is in virtue of this traction on the pedicle of polypoid tumors that intestinal obstruction occurs so frequently from invagination and intussusception. Where a tumor of the stomach is pediculated it is easy to conceive the mechanism by which it may cause sudden attacks of pyloric obstruction of a paroxysmal character with pylorospasm and pain of great intensity which may subside, to be followed by variable periods of calm. A pediculated, mobile tumor attached to the mucosa will act as a foreign body which the stomach will endeavor to eject through the pylorus. It will act in this way as a *ball valve* which will obstruct the pyloric ring or block the duodenum. The tumor itself may be large enough to block the pylorus or duodenum, but even a relatively small tumor may, by traction exercised by its pedicle on the gastric mucosa, drag this into and beyond the pyloric ring, thus not only completely obstructing it but favoring partial invagination of the stomach into the duodenum, thereby giving rise to the symptoms of strangulation as well as of obstruction.

This would constitute the *crisis*, or attack, in which, as in this patient's case, intense, agonizing pain in the epigastrium, with vomiting and collapse, followed by tarry stools and progressive anæmia, were the outstanding symptoms. When the pyloric and duodenal spasm relaxes, the symptoms subside and the patient enters into a period of calm which will vary in duration according to many circumstances. The tumor may be released from the pyloric grasp and retract into the stomach, where it may continue to roll about. Or it may lie quiescent in the relaxed duodenum, as in this case, until the continued effort at propulsion may drag the attached mucosa to the pylorus, there to undergo a repetition of the same herniation and strangulation. It is important to remember that these attacks may recur at *irregular* intervals regardless of the meal time or the quantity or quality of food.

The paroxysmal or intermittent character of these attacks, in which the period of violent suffering and collapse is followed by a stage of complete or relative calm, is a striking feature which is eminently suggestive of a "ball valve" pediculated tumor even when "occult blood" and tarry stools (melæna) with progressive anæmia add a graver cast to the clinical picture.

To direct the attention of surgeons to the nature and periodicity of these crises and their diagnostic significance from the clinical point of view is the main purpose of this paper. To synthesize the radiologic observations which have already accumulated in the literature of the last few years in a way that would stamp the distinctive features of the polypoid (pediculated) from the non-pediculated tumors and to separate the benign from the malignant, is indeed a worthy task which, however, I can only touch upon in this brief communication.

[NOTE.—No attempt has been made in this discussion to treat *pediculated gastric adenomata* systematically. The literature is now rich in monographic essays which have steadily accumulated since the classic paper of Brissaud (1885) and Menetrier (1888). Nor has any attention been given here to the rarest but most interesting type of multiple polyadenomatous polyposis *en nappe* or in plaques —which presents very distinct differential clinical and roentgenological characteristics. No mention has been made of a number of solitary pediculated polypi of the ball-valve type, which have been recognized at operation and successfully removed, as in the cases reported by Doyen (1895), C. L. Gibson (1907), J. A. Blake (1907), E. Novak (1920), N. Rankin (1921), and others, which are almost counterparts of the present case in the anatomical, patho-

logical, and operative details, but which differ very notably from the present instance in the lack of the grave clinical syndrome herein described.]

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SUBPERIOSTEAL RESECTION OF LONG BONES IN OSTEOMYELITIS

An Analysis of This Method of Treatment with a Report of 5 Cases

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SUBPERIOSTEAL removal of the shafts of bones which are more or less extensively involved by infection is a surgical procedure which has found a definite place in the treatment of diaphyseal osteomyelitis, as discussed in the standard textbooks on surgery. It is based on the principle that resection of the diseased portion of the shaft will remove the grossly infected bone, and that osteogenesis will take place from the periosteum to the development of a substantial new shaft.

Nichols[1] advocates the use of this method in subacute osteomyelitis when an accessory bone is present to act as a splint and maintain the length of the limb during the process of regeneration, such as in involvement of the tibia. He states that subperiosteal resection is indicated in cases in which there has been an extensive destruction of the entire diameter of the diaphysis over a greater or less extent. In his opinion if such a necrotic shaft is not removed it will persist as a sequestrum indefinitely, periosteal involucrum will form, and, if the sequestrum is removed later, the involucrum will not fill up the central cavity. He admits that the optimum time for the operation is not easy to determine, but that it averages about the eighth week after the acute infection has been stopped by the evacuation of pus. The results obtained he says, as far as function and use go, are *usually absolutely perfect*, and even in cases where the epiphysis is interfered with, the shortening may be slight and the function perfect. In osteomyelitis of those bones in which no accessory bone is present, he advises waiting until a sufficient involucrum has developed for support, and then the sequestrum is removed.

Warbasse[2] recommends subperiosteal resection for osteomyelitis of the tibia. He advises against its use in the femur and humerus, although he says that it may be used in certain cases and the limb maintained in proper position by the same form of splinting that would be used in the treatment of a fracture of the same bone. He prefers the establishment of free drainage of the necrotic diaphysis, the latter acting as a splint until the involucrum is sufficiently strong.

Stiles[3] discusses the operation of subperiosteal resection for "tuberculous osteomyelitis of the diaphysis." From his description of the various bones operated upon and the X-ray illustrations, it is quite evident that the bone involvement which he discusses, in most of the cases at least, was pyogenic osteomyelitis and not tuberculosis. He used the method in practically all of the long bones. His results are not specifically tabulated. He reports excellent results in many cases, but he mentions incomplete and limitation of bone regeneration, and deformities from bowing and shortening. His discussion of the subject is not convincing.

Some of the sources of failure in this operation are suggested by the three writers to whose articles reference has been made. There are three fundamental errors involved in the procedure of subperiosteal resection of the shaft of bone for osteomyelitis.

In the first place it is impossible to determine accurately, at the time when it is advised that the operation be performed, just what portion of the involved bone is necrotic.

It has been the common experience of any surgeon who has studied a considerable group of pyogenic bone infections, to note that bone which at an early period in the disease seems to be lifeless, may, upon the institution of proper drainage, not only not sequestrate but take a very active part in the process of repair. Until a line of demarcation is established between living and necrotic bone—gross evidence of sequestration—it is presumptive to

[1] Keen's Surgery, vol. ii.
[2] Keen's Surgery, vols. v and viii.
[3] Oxford Surgery, vol. ii, pp. 121–175.

Fig. 1. Fig. 2. Fig. 3. Fig. 4.

Fig. 1. Case 1. Six weeks following partial subperiosteal resection of the tibia.

Fig. 2. Case 1. Ten and one-half months after resection. There is a gap in which no bone is being formed. In the 9 months' interval since the roentgenogram shown in Figure 1 was taken, neither tibial fragment has increased appreciably in length. The lower fragment has become displaced upward in its relation to the fibula.

Fig. 3. Case 1. Anteroposterior roentgenogram of both legs taken 6 years following bone transplant. The re-formed tibia is much shorter and there is some rotation of the articular surface in the ankle joint.

Fig. 4. Case 1. Lateral roentgenogram views of both legs taken six years following bone transplant. Note the increased size of the fibula on the affected side.

remove a large segment of infected bone on the assumption that it is doomed.

If the periosteum is still attached to infected bone, that in itself is presumptive evidence that the bone is living. If the periosteum is separated from the cortex to circumscribe the shaft completely—a very unusual condition—then, in all probability, that portion of the diaphysis will become necrotic and eventually sequestrate. But even in this case necrosis may not be the end-result, if adequate drainage is established.

The extent of medullary involvement is no index of necrosis of the enveloping cortical bone. The medullary cavity may contain frank pus from one end to the other and yet complete healing occur without sequestration after the infection has been properly drained.

Necrotic bone on the other hand may serve a very definite purpose in a given case, granted that drainage into the infected bone is well provided for. It acts as a support to maintain a proper length for the extremity and to prevent angulation, bending, and pathological fracture, and it also stimulates osteogenesis from the living bone elements. In certain cases it seems to act as a scaffolding upon which and into which new bone grows. When sequestration has taken place then the separated bone acts only as a foreign body.

The second fundamental error in the operation of subperiosteal resection is to assume that regeneration will take place adequately from the remaining periosteum following resection. In stripping the periosteum from the cortex the most actively osteogenic portion of the whole bone may be left on the shaft and removed with it. Furthermore the technical procedure itself interferes with that portion of the blood supply of the periosteum received through the haversian system from the medullary cavity, and in some cases the freshly ex-

Fig. 5. Fig. 6. Fig. 7. Fig. 8. Fig. 9.

Fig. 5. Case 2. Extent of osteogenesis from the periosteum 9 months following subperiosteal resection of the tibia.

Fig. 6. Case 2. Extent of periosteal osteogenesis 2 years and 3 months following subperiosteal resection. Compare with Figure 5 and note how much new bone has been absorbed during the 18 months' interval. Also during this period the upper tibial stump has increased less than an inch in length. The gross defect between the upper and lower tibial stumps has increased about an inch, due to the growth of the fibula.

Fig. 7. Case 2. Lateral view of the leg to show the amount of re-formation of the tibia 2 years and 3 months following subperiosteal resection.

Figs. 8 and 9. Case 2. Result nearly 3 years after massive bone transplantation from the opposite tibia.

posed, bleeding, inner surface of the stripped periosteum becomes infected at the time of operation. All or any of these factors may inhibit the bone-producing activity of the periosteum — even though it had laid down a fairly substantial involucrum up to the time of operation.

This inhibition, if marked, may determine the complete absence of regeneration over a variable extent of the resected shaft. In other cases regeneration will be begun from the periosteum across the entire defect, but will stop far short of the amount necessary to reform a new shaft. Regeneration may reach a point of maximum amount and then absorption of some of the newly formed bone take place. It seems that this is, in certain measure, due to the lack of functional stimulation incident to the absence of the supporting shaft.

The third fundamental error in this operation is that the procedure is very likely to be followed by deformity. In the cases in which regeneration of bone is complete and rapid, and the resected bone is splinted by a neighboring bone, the deformity may be practically nil. In cases in which a long period of time elapses until a new shaft has developed, very definite shortening of the re-formed bone may take place.

In an actively growing child this may be due to retardation of growth of epiphyseal bone. Such limitation may be caused by operative injury to the epiphyses in total diaphyseal resections, or it may be due to a lack of

normal or functional stimulation of the epiphyses incident to the absence of the supporting shaft over a prolonged period.

In cases in which cast or brace support supplements the support of an adjacent bone and the patient is allowed to bear weight upon the extremity, an actual foreshortening of the resected bone may take place during the process of repair, and, in the leg, for example, considerable inversion of the foot may follow.

In bones unsupported by a neighboring bone, shortening is likely to be great. Practically it is impossible to maintain the normal length of the femur or humerus during the period of regeneration by any method of traction or cast support. Bending deformity is also difficult to prevent.

In over 300 cases of acute and chronic osteomyelitis which have entered the surgical service of the University Hospital between January 1, 1915, and May 1, 1923, the operation of subperiosteal resection has been performed in five. In two of these the operation was done in this hospital, while three came to the hospital because of the unsatisfactory end-result following the subperiosteal resection which had been performed elsewhere. In only one of the five cases did regeneration of bone proceed to the development of a weight-bearing new shaft. This was of the femur. The remaining four cases were of the tibia, the bone which theoretically should be the most satisfactory for this type of operation. In all of these, osteogenesis stopped far short of the production of a new shaft so that transplantation of bone became necessary to obtain a weight-bearing extremity. In four of the five cases, further operation was necessary following subperiosteal resection, before the infection was cured. In other words radical removal of the shaft of the infected bone did not completely eradicate the infection. In all of the cases considerable deformity occurred.

A description and analysis of these five cases follows:

Case 1. Margaret Murphy, age 3.

History on entrance to University Hospital, February 21, 1916. About 6 weeks ago the child burned one of the toes of her right foot, which seemed to heal satisfactorily. Two weeks later the toe became very painful. The following day a red, tender area was noted on the outer side of the ankle. This increased in extent and the leg became swollen, painful and tender from the ankle to the knee, and the patient had a fever of 104 degrees. One week later an incision was made and a large amount of pus found. The patient was brought to the University Hospital 4 weeks after the onset.

Fig. 10. Fig. 11.

Fig. 10. Case 3. Over 3 years after subperiosteal resection of the tibia there is a complete defect of the shaft. In the 9 months' period during which this boy has been under observation, no bone has been formed in the region of the defect and a detached piece of considerable size has been absorbed.

Fig. 11. Case 3. Result 5 months after transplantation of bone taken from the opposite tibia.

Examination shows a well-nourished girl of three, with left leg markedly swollen, reddened, and extremely tender. Leucocyte count 15,200.

X-ray shows extensive involvement of the medulla of practically the entire shaft of the tibia. There is irregular periosteal new-bone development. No sequestrum is demonstrated.

Operation, February 21, 1916. Ether anæsthesia. (Dr. C. J. Rowan.) Long incision was made over the tibia. The periosteum was incised and reflected from the bone. The lower half of the periosteum was very thick and firm and contained a shell of new bone, while the upper half showed no thickening or bone production except near the upper end. The bone was bloodless, but had not separated and was not loose at either epiphysis. With a chisel the medullary cavity was opened from one epiphysis to the other and found to contain pus. The bone cavity was packed with plain gauze and the incision partially closed by suture.

Course. The acute symptoms subsided. Drainage from the wound was profuse and did not subside. It was felt that major portion of shaft was necrotic.

Operation, March 24, 1916. Ether anæsthesia. The necrotic tibia was divided at its middle by Gigli

Fig. 12. Fig. 13. Fig. 14.

Fig. 12. Case 4. Roentgenogram taken about 7 weeks after the onset of acute osteomyelitis of the tibia, and just preceding subperiosteal resection.

Fig. 13. Case 4. Defect present 5 months after the operation.

Fig. 14. Case 4. Thirteen months have elapsed since the roentgenograms shown in Figure 13 were taken. No new bone is shown across the defect. The tibial stumps are slightly longer, but the defect is wider due to the efficient splinting by the fibula which has increased over an inch in length.

saw and cutting forceps, and each fragment avulsed from its point of beginning separation from the living bone. This left a defect representing approximately one-half of the shaft of the tibia. A plaster splint was applied.

Course. Gradual healing of the wound took place. From May until December, 1916, the patient was at home. At intervals sinuses would develop in the scar, drain for a time, and then heal over. She returned to the hospital in December, 1916, at which time three sinuses were present over the lower end of the tibia. There was incomplete regeneration of the tibia as shown by very free false movement through the middle third of the leg.

Operation, December 14, 1916. Ether anæsthesia. A localized area of infection just above the ankle joint was opened into and drained.

Course. Discharge became very much less and no no new sinuses developed. Patient returned to the hospital in February, 1917, at which time there was still a persistent sinus just above the ankle at the site of the last operation. There was slight decrease in the tibia defect. This was due in part to a very slight production of new bone from each fragment and in part to an actual foreshortening of the bone in spite of the support of the intact fibula and a supporting cast. Ten and one-half months had elapsed since the removal of the tibial shaft.

Operation, February 12, 1917. Ether anæsthesia. (Dr. C. J. Rowan.) The defect in the right tibia was exposed and the pointed end of each fragment freed by dissection. A graft, 2.5 inches in length, was cut from the left tibia, placed across the defect, and tied to the upper and lower fragments by chromic gut.

Course. The wound of the right leg became mildly infected, but the graft healed in spite of this infection and a solid bone developed giving a satisfactory weight-bearing tibia as the end-result.

Examination, May 2, 1923, six years following operation. There is practically normal range of motion of the ankle and knee joints. The foot is somewhat everted due to bowing of the tibia. The bone is solid and nearly of the same size as the left.

The right limb is 2 centimeters shorter than the left, measuring from the anterior superior spine of the ilium to the tip of the internal malleolus. The right tibia, however, is 4.5 centimeters shorter than the left. The femur on the affected side has become longer than that of the unaffected, due to the stimulation to which it has been subjected in walking incident to the difference in lengths of the two limbs. The fibula supporting the formerly diseased tibia is also markedly more sturdy than its opposite.

The girl is very active in every way.

Case 2. Fred Worrell, age 11.

History on entrance to University Hospital, December 31, 1918. Eighteen months ago the patient bruised the left ankle while playing ball. About 6 weeks later a dull ache was noticed in the leg above the ankle which gradually increased in severity until it kept him awake. Three days later the leg began to swell and this extended to the knee in a few days. Not long after he developed a similar pain and swelling of the forearm. A month later a pleurisy developed on the left side. The chest was incised but no pus was found. Several months after this a sinus developed over the right third rib anteriorly. Another sinus developed over the right upper maxilla, and one over the lower end of the right humerus.

An incision was made over the left leg at the onset of trouble and a great deal of pus obtained. A sinus persisted. Nine months ago a subperiosteal resection of the left tibia was done, a piece of bone, 8 inches in length, being removed.

Examination shows an anæmic looking boy of 11 years. There are sinuses over the right third rib, external condyle of the right humerus, distal end of right radius and ulna, upper end of the left humerus, and three sinuses in the scar over the left tibia. The operative scar over the left tibia is anteriorly placed and extends from epiphysis to epiphysis. The leg may be bent and twisted freely through a wide range. This is limited only by the intact fibula. No tibia is palpable except in the regions of the knee and ankle. X-ray shows an extensive gross defect in the shaft of the left tibia involving the whole bone except for a stump about 3 inches in length at the upper end and a shorter one at the lower. Between these two bone ends is an incomplete narrow ribbon of new bone which varies somewhat in width and thickness. Von Pirquet and Wassermann tests negative. Leucocyte count 18,200.

Operation, January 9, 1919. Ether anæsthesia. (Dr. C. J. Rowan.) The sinuses over the tibia were opened and found to lead to cavities in bone which contained spicules of bone and pus. These were curetted and packed with iodoform gauze.

Course. The limb was supported by a cast from the toes to above the knee, which was changed at

Fig. 15.

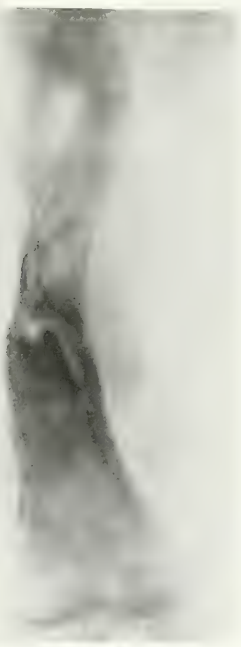

Fig. 16.

Fig. 15. Case 5. Eleven weeks after subperiosteal resection of a considerable portion of the shaft of the femur, osteogenesis is well established. Traction is applied to the limb by a Thomas hip splint. The mesial bending deformity was subsequently corrected in large measure.

Fig. 16. Case 5. Ten and one-half months after operation the new femur is well formed. Removal of a sequestrum from a central abscess was necessary before the infection was overcome.

varying periods. The wounds continued to discharge for several months but healing was complete by April, 1920. The ribbon of bone between the upper and lower tibial fragments became increasingly smaller in size due to absorption. When there had been no further evidence of infection for 4 months, bone transplant was performed.

Operation, July 24, 1921. Ether anæsthesia. (H. L. Beye.) A long incision was made over the anterior surface of the left leg lateral to the old scar and the ribbon-like tibia exposed. In places it was quite well formed and as thick as a pencil. In other places there was no true bone, but only a thick ribbon of tough periosteum surrounded by scar tissue. A graft was taken from the right tibia, 8.75 inches long and 0.75 inches wide, and of the full thickness of the bone from periosteum to endosteum inclusive. A bed was prepared in the left leg for the graft by splitting the ribbon-like tibia, and cutting a short trough in the tibial stumps with a chisel. The graft was laid in this bed and held in place by sutures, and the incision closed. Cast applied.

Course. A mild infection of the wound of the left leg took place which required that the incision be

Fig. 17. Fig. 18.

Figs. 17 and 18. Case 5. Three years after operation the femur is seen to be substantial. There is moderate posterior bowing. The limb is 7.5 centimeters shorter than the opposite.

opened at a few points for drainage. The graft lived in spite of it and grew actively. It even threw off from its anterior margin a shell-like sequestrum of considerable size, following which the wound healed completely.

End-result. A well-formed tibia developed from the grafted bone which assumed the size and shape of a normal tibia and the structural characteristics including a fairly well outlined medullary canal as shown by the X-ray. There is shortening of 6.5 centimeters of the limb, and some inversion of the foot due to the foreshortening of the tibia. Range of motion in the ankle joint is somewhat restricted. The boy is active, walks well with the shoe built up and has had no further evidence of infection in the leg and it is now nearly 3 years after the bone graft operation.

Operation was performed upon the involved rib and a cure obtained. The involvement of the superior maxillæ, right humerus, ulna, and radius subsided spontaneously.

Case 3. Carl Brewer, age 9.

History on entrance to University Hospital, October 3, 1921. January 10, 1919, the patient developed severe pain in left leg, referred especially to the ankle, and had a fever of 102 degrees. In 16 hours the entire leg was swollen and reddened. Three weeks following onset, incisions were made in the soft tissues and considerable pus obtained. During the sixth week of illness, the leg became fractured on turning over in bed. The following day the patient was taken to a hospital for operation. The "bone was sawed and chiseled out," following which improvement began at once, and healing of the wound was complete in 4 months. Casts were applied at intervals for 18 months and then a brace was used. A few days after the leg was incised for drainage a red tender "gathering" appeared in the right wrist. This was incised, pus obtained, and this infection was healed in about 4 weeks. It has caused no later trouble. Was sent to the University Hospital for a bone graft operation 31 months following resection of the tibia.

Past history. No history of trauma to the leg can be obtained. Denies furuncles or other skin infections. Otherwise negative.

Examination shows a well-nourished boy of 9. General examination negative. Left leg presents a scar over practically the entire anterior aspect of the tibia, with three small scars lateral to this, where the initial drainage had been established. The leg is 7 centimeters shorter than the right. A palpable defect in the tibia of about 1.5 inches is present in the middle third. There is free motion of the leg in all directions through this defect. There is considerable atrophy of the calf muscles. Ankle and knee joint movements are satisfactory. X-ray examination shows a gross defect in the middle third of the tibia of about 1 inch. The upper tibial fragment tapers to a point and is quite dense. The lower tibial fragment is also tapered, and its most proximal portion is separated from the remainder by what seems to be a fracture line. Lateral to the defect between the two main tibial fragments is a sclerotic fragment of bone which is entirely separate from the remainder of the tibia. There is no evidence of active infection.

There is a greater defect in the tibia than is apparent. This is due to the fact that, although the fibula has tended to maintain the normal length of the leg, actual displacement of the upper tibial fragment downward, and of the lower tibial fragment upward, has occurred. This has foreshortened the leg considerably. The fibula is also shorter than that of the normal leg, and due to the unusual stress which has been put upon it, it has become more sturdy.

Inversion of the foot due to tilting of the lower fragment is quite marked.

Course. The leg was massaged daily to better the condition of the soft tissue, make the scar more supple and to light up any latent infection. The boy ran an irregular low grade fever and developed a local point of tenderness in the upper tibial fragment. Operation was performed and a well-localized abscess, the size of a navy bean, found which contained chronic granulation tissue. It lay in very sclerotic bone. Healing was slow, but was complete by February 1, 1922. He was sent home on crutches with the limb supported by cast.

Bone graft operation was performed June 30, 1922, (H. L. Beye), after the former operative wound had been healed for 5 months. During this interval no evidence of osteogenesis was present in the X-ray pictures, and the fragment of bone which had lain on the outside of the gap, between the upper and lower tibial fragments, was almost completely absorbed. A tibial graft, 8.5 centimeters long and 1.5 centimeters wide, consisting of the full thickness of the tibial wall, was taken from the right leg and transplanted into the left tibia. In addition small "cambium grafts" (thin chips of cortex with attached periosteum) were laid along the massive graft in the defect between the upper and lower tibial fragments.

Postoperative recovery was uneventful.

End-result. The result is very satisfactory as far as the development of a solid weight-bearing tibia is concerned. The left limb is 7.5 centimeters shorter than the right for which the boy wears an extension sole and heel. He also wears a brace to correct the inward bowing of the leg and inversion of the foot due to the foreshortening of the tibia, and gets around very actively.

Case 4. Bessie Van Matre, age 4 years. Seen in office consultation in September, 1922. This case is reported through the courtesy of Dr. John R. Harger, of Chicago, to whom I am indebted for the X-ray illustrations and the clinical data.

History. At the age of 2½ years, this patient had an acute attack of osteomyelitis involving the entire shaft of the tibia. When seen by Dr. Harger 7 weeks after onset she was desperately ill. At that time the leucocytes numbered 15,000, hæmoglobin was 60, and the red cells were below three millions. X-ray examination of the tibia showed a very extensive involvement with considerable central destruction. Operation was performed in March, 1919, at which time complete subperiosteal removal of the infected tibial shaft was done.

Course. A satisfactory recovery took place with complete healing of the wound and no evidence of further infection after 6 weeks. Regeneration of the tibia from the periosteum has not taken place, so that there is a wide defect between the short bone stumps of the upper and lower ends of the tibia, 4 years following operation. An analysis of the X-ray pictures taken about 1 year and 6 months following operation and compared with those taken 2 months after operation, shows that there has been a slight increase in length of the lower stump. Whether this is due to regeneration from periosteum or to epiphyseal bone growth, it is impossible to say. There has been practically no increase in length of the upper stump. The defect between the two stumps has increased in spite of the slight lengthening of the lower stump. This is due to the efficient splinting by the fibula

which has grown well over an inch in length in this 18 month period. The fibula of the affected side is only about 1 centimeter shorter than the one on the normal side, while there is a difference of 2.5 centimeters in the comparative lengths of the two tibiæ.

CASE 5. Lewis Chambers, age 14.

History on entrance to University Hospital, April 22, 1919. In early March, 1919, the patient developed an infected abrasion over the left heel from an ill-fitting shoe. About three days after this both knees, and the left elbow, and the left ankle became swollen, painful, tender, and red. These symptoms gradually subsided. About 3 weeks after this a painful swollen tender area developed over the anterior surface of the right leg below the knee. This was incised and pus obtained. A diagnosis of osteomyelitis of the tibia was made and the boy sent to the University Hospital, about 6 weeks after onset.

Examination. General condition poor. The boy appears anæmic and septic. Pulse rate 120. Over the right tibia in the middle third are two sinuses leading to bone, and tenderness is marked over the entire bone. There is tenderness on deep pressure over the left tibia and the leg and ankle are swollen and œdematous. The left thigh is swollen from the knee to the hip and there is slight tenderness over the femur. Urine analysis shows: specific gravity, 1.022; albumin, negative; many hyaline and granular casts. Hæmoglobin, 79 per cent; leucocyte count, 19,800.

X-ray examination. Extensive osteomyelitis of the left femur involving the entire shaft is present. In the middle third there is considerable destruction of the cortex on the mesial and posterior aspects. The medullary cavity throughout is moth eaten, and small abscess cavities may be made out. There is no evidence of gross sequestration. Periosteal production of new bone is well established and is excessive in the middle third overlaying the area of cortical involvement. The knee joint is intact. There is involvement of the upper third of the right tibia and lower third of the left.

Operation, April 24, 1919. Ether anæsthesia. (Dr. E. M. Miller, Chicago.) A long incision was made over the outer side of the left thigh to the femur. Pus was found around the bone. The periosteum was much thickened and new bone was formed from its under surface. Pus was present between the periosteum and cortex. Almost the entire shaft of femur seemed to be necrotic, so a subperiosteal resection of the shaft was done. The wound was lightly packed with plain gauze and left widely open. An incision was also made over the right tibia to drain the abscess in the soft tissues overlying the bone.

Course. Immobilization of the left limb and traction maintained by a Thomas splint. The wound of the thigh was treated by the Carrel-Dakin method, and healing progressed satisfactorily. Sufficient traction could not be obtained by Buck's extension to maintain the normal length of the extremity, so that calipers were applied to the lower end of the femur above the condyles. Even by weight traction on the calipers with the limb supported in a Thomas splint slung from a Balkan frame, gradual shortening of the extremity took place during the course of wound healing. A hip spica was applied on the one hundred and third day following operation. Bone developed from the periosteum to form a new and solid femur, but a persistent sinus leading into the depth of the new bone remained.

Operation, April 24, 1920. (H. L. Beye.) Nitrous-oxide anæsthesia. Incision through the old scar on outer aspect of left thigh to expose the sinus. The latter led to the interior of the very dense femur. A piece of the latter was removed by chisel and an abscess cavity exposed containing a sequestrum, 2 inches long and three-quarters inch wide.

Course. Uneventful recovery with the wound healed completely at the end of about 3 months. The patient was operated upon again in September, 1920, because of the infection of the right tibia. An extensive abscess was opened, containing a large sequestrum. Healing was uneventful.

End-result. A solid, weight-bearing femur was obtained with infection seemingly entirely overcome 15 months after the operation of subperiosteal resection. There is complete extension of the knee but flexion is limited to an angle of 110 degrees. In spite of every effort made to prevent shortening, the left limb is 7.5 centimeters shorter than the right. How much of this is due to contracture of the thigh muscles, and how much to inhibition of epiphyseal bone growth because of absence of stimulus over a long period of time, it is impossible to state.

The boy now gets around actively although with a decided limp, and there has been no evidence of further trouble nearly 3 years following complete healing of the thigh.

CONCLUSIONS

It is fundamentally unsound to do a subperiosteal resection of the shaft of a long bone for osteomyelitis.

In performing such an operation bone may be sacrificed, which if properly drained, would not only be viable but play an important part in the restitution of the diseased shaft.

Regeneration of bone from the periosteum remaining after subperiosteal resection may be limited and stop far short of a functional end-result.

Deformities are likely to follow such an operation with resultant functional disability.

The radical removal of diseased bone by this procedure does not necessarily mean that infection has been eliminated.

DUODENAL HERNIA—A MISNOMER

By EDMUND ANDREWS, M.D., Chicago

MY attention was drawn to the unusual condition of duodenal hernia, by the case which is outlined as follows:

W. D., had suffered from slight, vague, gastric distress for several years. This in itself had been negligible, but at times a large, palpable mass had appeared in the abdomen. This mass varied in size and was always soft and fluctuating. After considerable study Dr. B. W. Sippy made a diagnosis of probable mesenteric cyst and referred him for operation, which was performed by Dr. E. Wyllys Andrews and the author. The entire small intestine, except for a few inches at its upper and lower ends, was found enclosed in a sac of peritoneum. Large vessels, which could not be identified, lay about the mouth of this sac. A small opening was made at the fundus, and it was found that the entire contents were matted together by universal, fine, cobweb-like adhesions. The patient's symptoms did not warrant such a severe procedure as reduction of the bowels, and therefore the hole in the sac was closed and the abdomen sutured. The condition was a duodenal hernia, but it was impossible to say whether it was a right or a left one. Figure 1 taken from Moynihan represents exactly the condition found in our case.

The older literature on this subject is voluminous, and many careful studies of the various folds and fossæ about the duodenojejunal junction have been made. Hundreds of cadavers, not only of adults but of infants and fetuses, have been examined and every possible type of fold and pouch has been catalogued and named. No one individual has all these structures, and they should really be classed as variants. The most painstaking and minute descriptions are those of Treitz (95), Waldeyer (100), Gruber (36), Eppinger (23), Landzert (53), Jonnesco (47), and Broesike (11). They are admirably summed up by Moynihan (63) in his book on *Retroperitoneal Hernia*. He enumerates nine fossæ as follows: (1) superior duodenal fossa; (2) inferior duodenal fossa (with (1) makes up fossa of Treitz); (3) paraduodenal fossa (fossa of Landzert); (4) mesocolic fossa; (5) mesentericoparietal fossa (fossa of Waldeyer); (6) posterior duodenal fossa (fossa of Gruber); (7) recessus intermesocolicus transversus; (8) duodenojejunal fossa; (9) infraduodenal fossa.

He considered only the first five to be of any practical importance. Numbers 1 and 2 or combinations of them are said to be the anlagen for left duodenal hernia, No. 5 for mesocolic hernia, and No. 4 for right duodenal hernia. This classification differs from some of the earlier ones, notably that of Broesike (11), but it has been almost universally accepted.

There is not a dissenting voice to the view that such small peritoneal pouches are the starting points for these enormous hernias. The prevalent conception seems to be that perhaps one of the pockets was congenitally a little larger and that into this a loop of bowel herniated. By gradual expansion the sac was stretched larger and larger until practically all the small intestine was swallowed up. Treitz (95) (quoted by Moynihan) writes as follows:

"The essentials . . . enumerated as being indispensable for the formation of a left duodenal hernia are three, namely: (1) the existence of a fossa and its boundary folds; (2) the presence of the inferior mesenteric vein in the fold; (3) freedom of movement in the small intestine to such an extent as to permit of its introduction into the hernial sac formed at the expense of the fossa."

Moynihan (65) himself says: "In its gradual augmentation of size, the hernia will be affected by (1) the laxity of the retroperitoneal tissue and (2) the extensibility of the peritoneum.

"1. The subperitoneal tissue is the stratum in which the hernial sac rests, and from the first the increase in size of the hernia is due to the sac pushing its way in and among this generally lax membrane. If for any reason the subperitoneal tissue should be unusually dense, fibrous, inelastic, or inexpansible, to so much greater a degree will the increase of the hernia be impeded.

"2. So far as concerns the extensibility of the peritoneum, there is little to be said. In the absence of any adhesions, the result of an old peritonitis, the membrane lends itself readily enough to any increase in size of an intra-abdominal tumor, wherever originating."

Since the publication of Moynihan's book (1906) as each case has been discovered and published, the same mechanism has been assumed and the same authors and theories quoted in a multitude of papers. The absurdity and grotesqueness of this whole conception must be evident from a consideration of the following facts:

1. *Differential pressure is utterly lacking.* All these pouches are enclosed within the abdominal walls in exactly the same way as is the general peritoneal cavity. None of them reaches outside in any way or is in the neighborhood of any opening. As intra-abdominal pressure increases, the rise must be just as high within the pouch as in any other part of the belly. In other words, the pressure in the main cavity can never rise higher than within the pouch. Any *vis a tergo* to account for the formation or growth of such a hernia is totally absent.

2. There are literally *hundreds of similar folds and fossæ* in the peritoneum, many of which are of much greater size, and they are practically never the sites of such "hernias." About the broad ligaments, the transverse mesocolon, the root of the great mesentery, about the splenic and hepatic flexures of the colon, not to mention the foramen of Winslow, occur all the features of the anatomy of the duodenal folds only vastly more pronounced in character and greater in size.

3. In all but a very small minority of cases reported, *the degree of herniation has been total or subtotal.* Seldom is there more than 15 to 20 centimeters of the small intestine in its normal position. How can one conceive of a force which would, once begun, practically always continue to act until all the guts had been segregated into a sac, even when the rest of the belly was empty? Jonnesco (66) has tabulated the *smallest* cases on record. The measurements refer to dimensions of the sac.

Reporter	Centimeter
Gruber	2.5– 1.5
Lambl	8. –10.
Gruber	11. –14.
Lambl	14. –12.
Krauss	18. –12.
Krauss	20. –16.5
Gruber	24.5–14.5

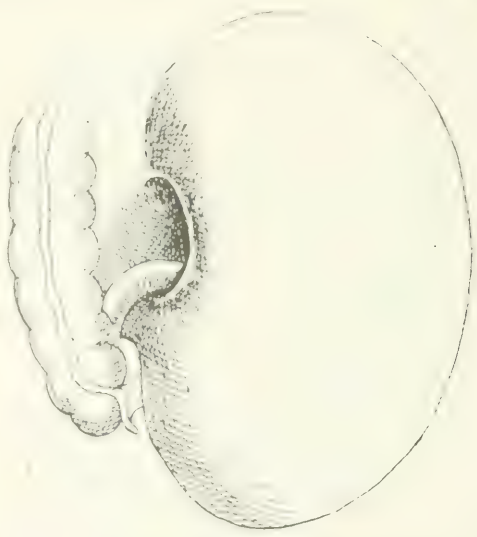

Fig. 1. Schematic drawing taken from Moynihan and representing exact condition found in author's case.

It will be noted that even of these smallest ones, the last three are large enough to have contained most of the small bowel. A few smaller ones have been reported since, notably MacArthur's (55) which I believe to be the smallest on record.

Of the 60 cases I have collected, 90 per cent have over one-half of the small bowel in the sac. Of this 90 per cent all but three were total or subtotal.

4. Vogt (98) reports a case in which such a hernia was found total in a newborn infant. Several others have been reported in the very young (Manski, 50). Surely one cannot believe that intra-abdominal pressure *in utero* has been the cause of such a "hernia."

5. The herniated viscera are never anything but small bowel. Omentum, the viscus found in nine out of ten hernias of other sorts, has never been reported as being in the sac. In only one case, that of Pybus (77) was a few inches of the descending colon herniated. This is the only report in which any other viscus is involved.

6. In many of the cases there has been an almost universal growing together of the contents of the sac. Kohlmann (50) has applied the term "totalis accreta" to this condition. It has often occurred in cases giving no history of strangulation. Heller (40) speaks

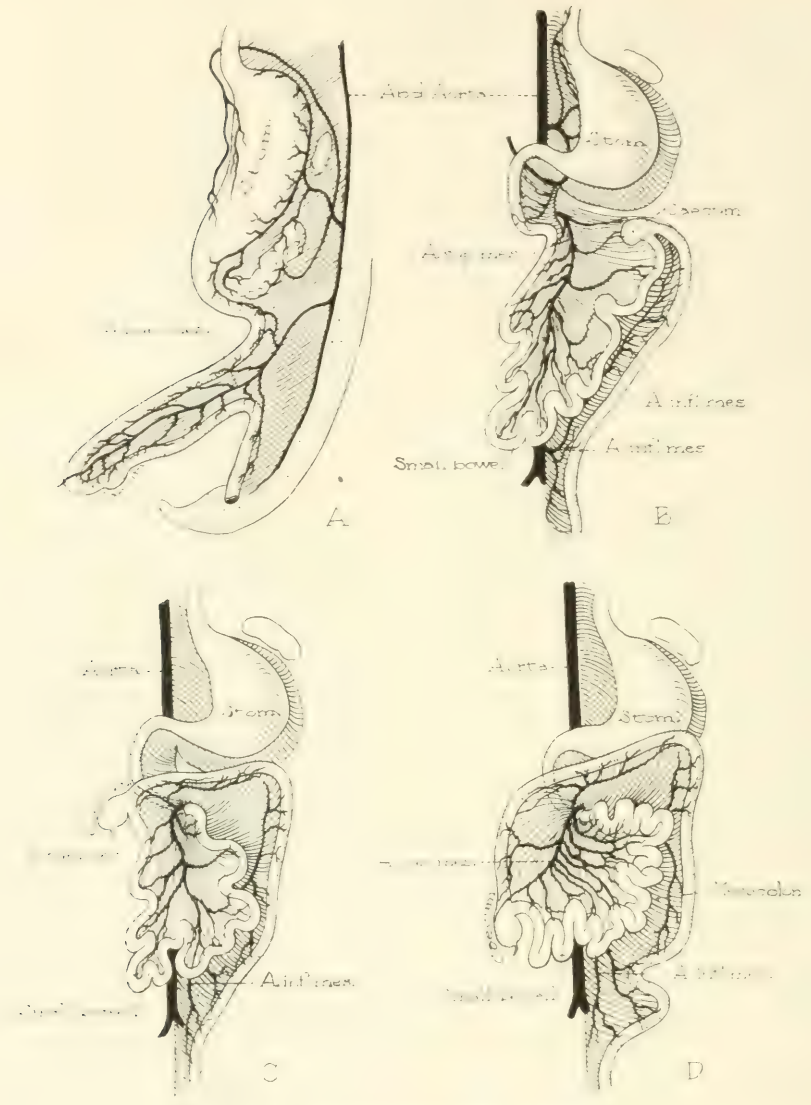

Fig. 2. Normal development of colon.

of this and the author's case was of this same type. The adhesions are not strong and firm and do not give the appearance of being inflammatory. They are thin, and the whole has rather the appearance of retroperitoneal tissue.

In my opinion this disease is a *congenital anomaly in the development of the peritoneum.* If looked at in this light, the explanation of these so-called hernias is quite simple and rational. By this means also can the various pericæcal hernias be explained.

Let us consider for a moment the normal development of the peritoneum. In the second month of intra-uterine life the cæcum lies above the umbilicus and generally a little to the left (Fig. 2, *b*). The small intestines are in the lower right half of the belly. This condition is brought about by a rotation on its long axis of the umbilical loop of Todt (Fig. 2, *a*). This is the first loop formed in the hitherto straight intestinal canal. It projects outside the body into the yolk stalk, and at its end is

given off the omphalomesenteric duct. This may persist as a Meckel's diverticulum. Failure of this loop to be re-included within the body gives rise to amniotic hernia. This loop is the anlage of the jejunum, ileum, ascending colon, and most of the transverse colon, the entire superior mesenteric artery tract. Normally a rotation of the entire loop occurs. The distal limb swings to the left and upward, coming to lie in the left upper quadrant (Fig. 2, *b*). It will be noted that this rotation takes place in the opposite direction to that in which the cord is usually twisted.

As the small gut grows rapidly and its coils multiply, the development of the colon progresses more slowly and in a much less haphazard manner. At this stage, ascending and transverse colons do not exist. As the upper end of the colon grows, it spreads to the right and its mesentery forms the transverse mesocolon (Fig. 2, *c*). The cæcum grows much more slowly and it is only when the hepatic flexure has become established and fixed that the downward growth of the descending colon begins. As it finally reaches down into the iliac fossa, its mesentery becomes attached to the posterior abdominal wall and fuses with it (Fig. 2, *d*). To sum up, the colon grows across the abdomen superiorly to the small bowels and then down, thus avoiding imprisoning them in its mesentery.

The simplest form of anomaly will produce a so-called right duodenal hernia. In this form the sac lies to the right of the duodenum and the superior mesenteric artery or the ileocolic artery always lies in the free edge of the fold making the anterior sac wall (Fig. 3). Let us now suppose that the rotation of the umbilical loop is not carried to completion. I venture to offer the suggestion that this may be due to its remaining outside the body too long and being involved in the opposite twisting of the cord, or by the persistence of the allantois to a later stage. In Borchard's (9) and also in one of Aschoff's (3) cases, a persistent Meckel's diverticulum was noted, and in several others duodenal hernia was associated with other defects in the development of the abdomen.

The cæcum then would not lie superior to the small intestines (Fig. 4, *a* and *b*), and, as it

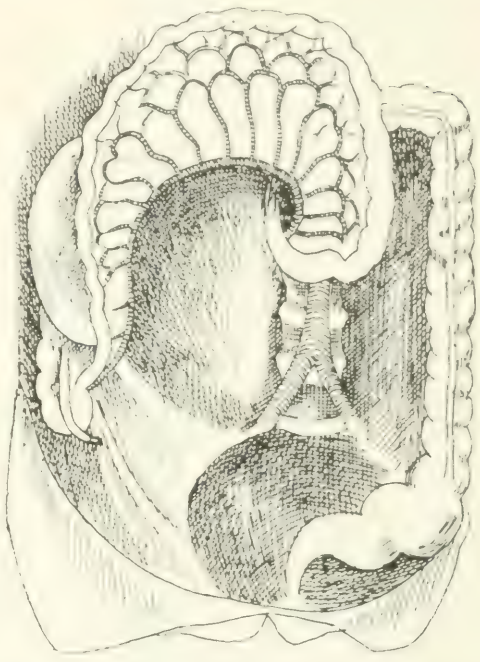

Fig. 3. Right duodenal hernia, showing orifice of the sac bounded by the superior mesenteric and ileocolic arteries (*Gerard-Marchant.*)

grew to the right, the small bowel would be caught in its mesentery (Fig. 4, *c*), and finally when its mesentery became adherent to the right posterior abdominal wall, the imprisonment would be complete (Fig. 4, *d*). The superior mesenteric and ileocolic artery would lie in the free edge of the neck of the sac. All the conditions of a right duodenal hernia are exactly reproduced.

The mode of origin of a left duodenal hernia is merely a higher degree of the same process. In this condition the hernia lies to the left of the duodenum and the free edge of the sac has the inferior mesenteric artery and vein in it (Fig. 5). The hernia lies between the artery and vein which make up the "fascular arch of Treitz" (Fig. 6). Now let us suppose that no rotation of the loop occurs, or perhaps there is a little in the wrong direction (Fig. 7, *a*). The cæcum would then lie to the right of the mid line in the lower abdomen. The colon runs straight to the rectum. As it gains in length, it forms a loop, and when the cæcum seeks its normal primitive position in the left upper quadrant, the small bowel is caught be-

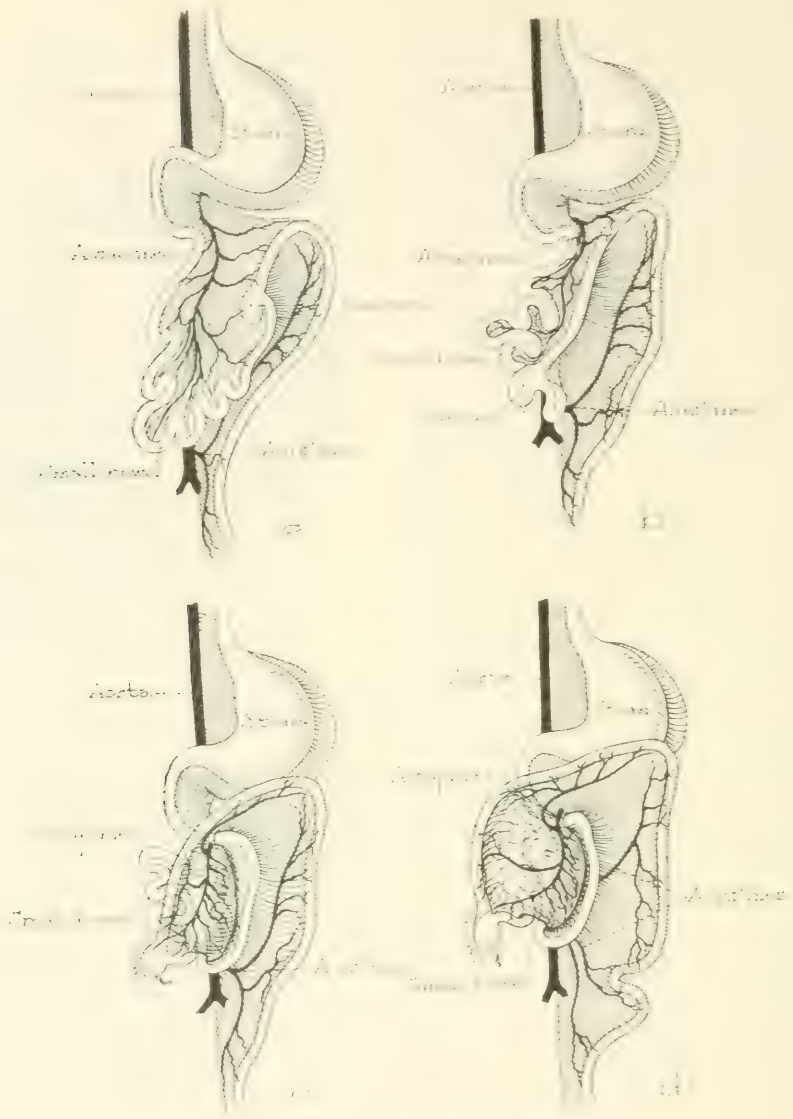

Fig. 4. Production of right duodenal hernia.

neath the mesentery of the descending colon (Fig. 7, *b* and c). The inferior mesenteric artery would then lie in the free edge of the sac neck and the vein would lie above, thus making the vascular arch of Treitz, which has been noted in most of these hernias.

Moynihan, in 1906, collected 74 cases of duodenal hernia, 57 of which he classified as left, and 17 as right. Since that date no complete collection has been made. Short (89), in 1916, gathered 14 since 1906, and Desjardines (20), in 1918, added four more. The reader must be referred to Moynihan's book (63) for the details of his cases. Short's and Desjardines' are included in the following series of 60 cases which I have collected since 1906. (Table I.)

The following articles were for various reasons not available, but I have reason to believe either from their titles or from references made by others that they record actual

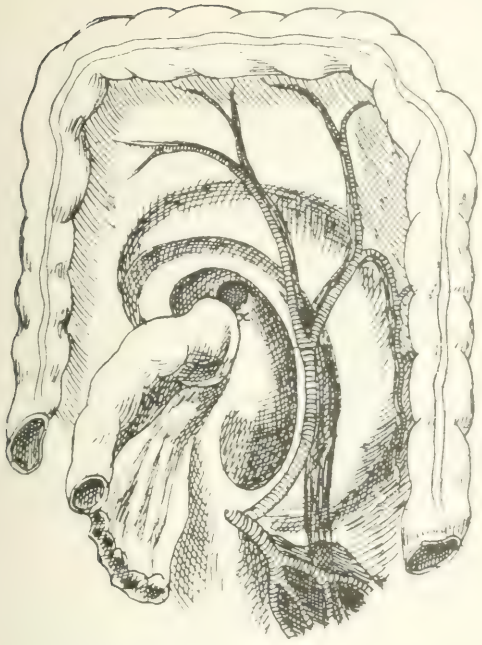

Fig. 5. The fossa of Landzert and the fossa of Gruber, *x*. Paraduodenal fossa and posterior duodenal fossa. (*Moynihan.*)

cases. D'Este (21), Eisler and Fischer (22), Iacobovici (46), Lamas (52), Levit (54), Scholz (85), Strohmeyer (92), and Wagner (99).

The cases shown in Table II, reported prior to 1906 are not included in Moynihan's collection.

In such a work as this it is certain that there has been some reduplication of cases, in spite of all precautions. In my tables, I have included no two cases of the same age and sex in order to avoid this. Nevertheless it may be that some of those published as museum specimens have been previously published without the second reporter knowing of it. I have not attempted to classify my cases right or left, as this has in many cases seemed a matter of great doubt. I have also omitted all mention of cases of mesocolic hernia, although I believe it quite possible that it has a similar origin.

Finally, I have appended a list of references to duodenal hernia not in Moynihan's bibliography, many of which I have not been able to consult. Many of these are duplicates of the cases reported, as for example when

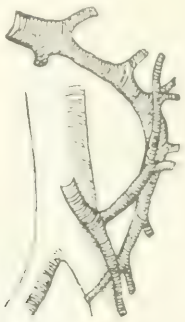

Fig. 6. The "vascular arch" of Treitz. (*Moynihan.*)

both the pathologist and the surgeon reported different aspects of the same case in different journals.[1]

Most of the earlier cases were observed post-mortem. However, of the 61 reported since 1906, 34 were operated upon, most of them during a crisis, and 12 died, a mortality of 36 per cent. None of the three operated upon during a quiescent period died. This does not, however, tell the whole story. In several of the cases reported recovered no radical cure was attempted. In these the patient got well in spite of the operation and not on account of it. If these are omitted it brings the mortality of operative cure well over 50 per cent. In some cases, universal adhesions prevented any attempt at reduction. (Author's and Heller's (40) and others.) In others the symptoms did not warrant the attempt, as the hernia was only incidental pathology and had given no trouble. In most cases the reduction has proven difficult. The ring cannot be enlarged on account of the important blood vessels in the neck of the sac. Extreme force is often necessary and tearing of the bowel has often occurred. Shock is intense from much handling of the intestines. The majority of fatalities have been due to peritonitis or shock.

Only one case has been diagnosed before operation, that reported by Sherren (88). In our case the diagnosis made by Dr. Sippy, mesenteric cyst, was as close as it is possible to come. Although they did not suggest the true diagnosis the radiological findings were typical. Kummer has described these and they corresponded closely with those found in our case.

[1] See references in bibliography before which asterisk appears.

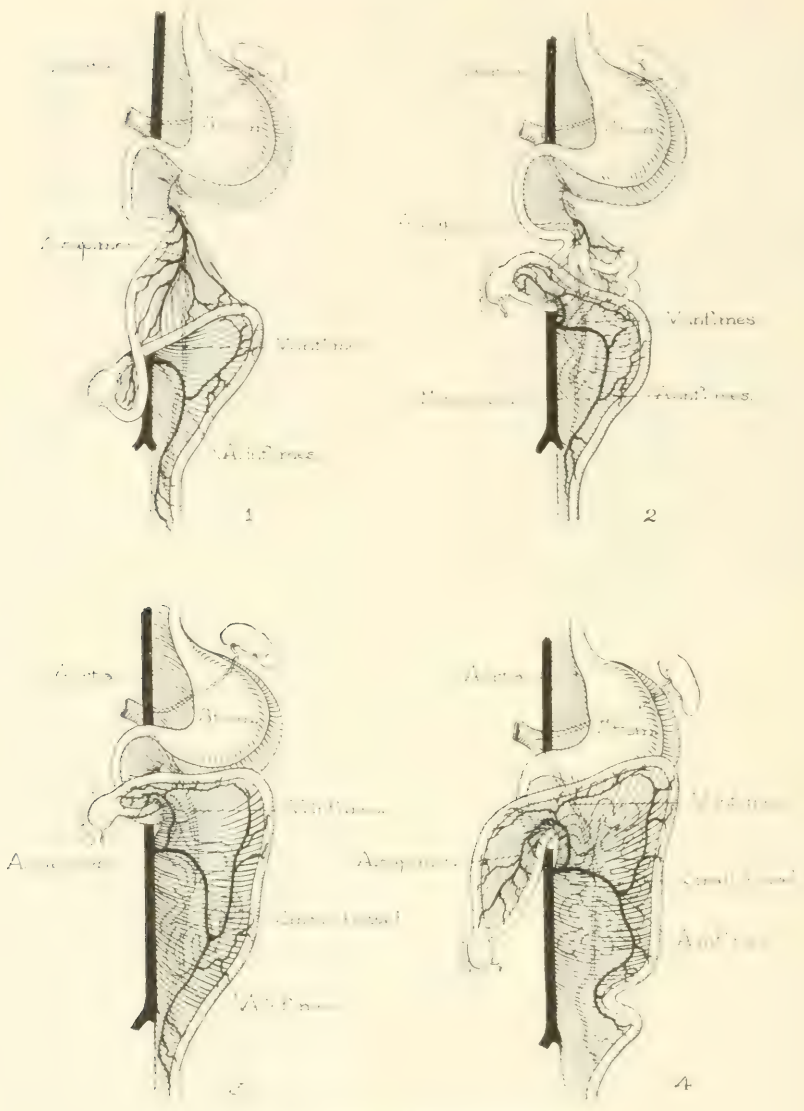

Fig. 3.—Production of left duodenal hernia.

Of all cases on record the greater number gave no symptoms whatsoever and were discovered only accidentally at postmortem or in the course of a laparotomy for some other condition. In those which did make trouble, there was generally a history of several previous acute abdominal crises. When first seen patient presented a picture of acute ileus: shock, collapse, vomiting, tympanites, obstipation. A palpable mass, generally on left side and of variable size, was noted in only a few cases.

CONCLUSIONS

Duodenal hernia is a congenital anomaly due to imprisonment of the small intestine beneath the mesentery of the developing colon.

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TABLE I.—CASES REPORTED SINCE 1906

		Sex	Age	Pm.	Op.	Strang.	Rec.	Type	Degree	Symptoms	Remarks
1	Barker (4)	M	50	o	x	o	x	lt.	Total	None	Discovered incidentally in operation for cancer of stomach.
2	Bassedas (5)			x	o	x	o	lt.	Total	Acute ileus	Found at autopsy.
3	Basset (6)	M	80	x	o	o	o	lt.	1 meter	None	Died of cardiorenal disease.
4	Basset (6)	M	26	x	o	o	o	rt.	Total	History unknown	Specimen from museum.
5	Basset (6)	Child		x	o	o	o	rt.	1–2 cm.	History unknown	Specimen from museum.
6	Beneke and Lorenza (7)	M	45	x	o	o	o	lt.	Total	None	Died of nephritis.
7	Borchard (9)	M	32	x	x	x	o	lt.	Subtotal	Acute ileus	Not discovered at first operation; found at second.
8	Bramlett and Ashhurst (10)	M	47	o	x	x	o	lt.	Subtotal	Acute ileus	Died on ninth day because wound broke open.
9	Carson (14)	M	29	o	x	?	x	rt.	Subtotal	?	Discovered at laparotomy.
10	Crescenzi (15)	...	...	o	x	o	x	lt.	Subtotal	Ileus twice previously	Stormy convalescence.
11	Crisler (16)	...	...	...	x	x	x	?	?	?	Reference not available; referred to by Short.
12	Davis (18)	M	48	o	x	x	o	lt.	Total	Acute abdominal crisis	Reduced with difficulty on account of adhesions.
13	Dayton (19)	M	50	x	o	o	o	lt.	Total	None	Died of tuberculosis
14	Desjardines (20)	M	50	x	o	o	o	lt.	Total	None	Died of lymphosarcomatosis.
15	Felton (24)	F	15	o	x	o	o	lt.	Total	Mass in abdomen	Diagnosed as ovarian cyst.
16	Giemanovich (28)	...	.....	...	...	...	.....	rt.	...	Details not available	Not available
17	Gierke (30)	M	64	x	o	o	o	lt.	8 ft.	None	Died after prostatectomy.
18	Giessen (29)	...	...	...	x	x	x	?	?	Details not available	No other details available.
19	Gobiet (31)	M	28	o	x	x	x	lt.	Subtotal	Acute ileus	Bloody fluid in belly.
20	Grad (33)	F	52	o	x	o	x	lt.	Subtotal	Backache	Cured by operation; easily reduced.
21	Harttung (39)	M	44	o	x	x	x	lt.	Half	Ileus chronic	2.20 meters gut resected.
22	Harttung (39)	M	54	o	x	x	o	lt.	Total	Acute ileus	Reduction very difficult.
23	Haasler (37)	M	43	x	o	x	o	lt	Total	Vomiting	Operation for cancer of colon. Hernia not seen. Death in 4 days from strangulation of hernia.
24	Haasler (40)	M	10	x	x	x	o	lt.	Total	Chronic dyspepsia	Reduction very difficult.
25	Hallock (38)	F	Adult	x	o	o	o	lt.	Total	?	Not cause of death.
26	Heller (40)	F	Adult	o	x	x	x	lt.	Total	Acute ileus	Universal adhesions prevented reduction. Sac incised to relieve tension.
27	Hichens and Odgers (44)	F	40	o	x	x	x	lt.	Total	Acute ileus	Adhesions noted.
28	Kohlmann (50)	M	51	x	x	x	o	lt.	Total	Abdominal pain and mass	Died of peritonitis.
29	McCallum and Liller (56)	M	41	x	x	x	o	lt.	Total	Acute ileus	Died of pneumonia.
30	Maschke (58)	M	36	x	x	x	o	lt.	...	Acute abdominal pain	Died 7 days after appendectomy done for this crisis. Hernia not noted.
31	Maschke (58)	F	63	x	o	o	o	lt.	Total	None	Died of nephritis.
32	Mathews (59)	M	35	o	x	x	x	lt.	Small loop	Acute abdominal pain	Cured.
33	Merckel (60)	F	40	x	o	o	o	lt.	Total	None	Found at routine post.
34	Mueller (68)	M	47	x	x	x	o	lt.	Subtotal	Acute ileus	Died of shock.
35	Mueller (68)	...	...	x	x	x	o	lt.	Total	Acute ileus	Operation failed to discover hernia.

TABLE I.—CASES REPORTED SINCE 1906, *Continued*

		Sex	Age	Pm.	Op.	Strang.	Rec.	Type	Degree	Symptoms	Remarks
36	Nixon (69)	M	30	o	x	o	x	lt.	Subtotal	Repeated abdominal crises	Easily reduced.
37	Nuzum and Nuzum (70)	M	40	x	o	o	o	lt.	Over ½	None	Routine autopsy; died of pneumonia.
38	Obrastzow (71)	F	17	x	x	x	o	lt.	Subtotal	Acute ileus	Paper available only in abstract.
39	Pikin (73)	F	27	o	x	x	x	?	Subtotal	Mass in abdomen	Paper available only in abstract.
40	Priebatsch (75)			x		x	o	lt.	Total	?	Museum specimen; no history.
41	Pringle (76)	M	40	o	x	o	x	lt.	Subtotal	Mass in abdomen	Last 2 to 3 inches could not be reduced.
42	Pybus (77)	M	5	o	x	o	x	lt.	Total	Colic	Had some colon in sac.
43	Scheele (82)	M	28	o	x	o	x	lt.	Total	Constipation	Cured.
44	Schopf (86)			x	o	o	o	lt.	Total	?	Museum specimen; died of other causes.
45	Schopf (86)	F	30	x	o	o	o	lt.	Subtotal	?	Museum specimen; died of other causes.
46	Schopf (86)	M	Old	x	o	o	o	lt.	Total	?	Museum specimen; died of other causes.
47	Schopf (86)	Adult		x	o	o	o	lt.	1st loop jejunum	None	Museum specimen; died of other causes.
48	Schopf (86)	Adult		x	o	o	o	lt.	12 cm.	?	Museum specimen; died of other causes.
49	Schopf (86)	Adult		x	o	o	o	?	Subtotal	None	Found at routine autopsy.
50	Schopf (86)	Adult		x	o	o	o	lt.	⅓ small gut	None	Found at routine autopsy.
51	Schoeppler (84)	F	80	x	o	o	o	lt.	Total	None	Died of tuberculous kidney.
52	Sherren (88)	F	14	o	x	x	x	lt.	Subtotal	Diagnosed	Acute ileus; mass in abdomen.
53	Thomas (94)	M	32	x	o	o	o	lt.	Total	None	Found at routine autopsy.
54	Thomas (94)	M	2	x	o	o	o	lt.	Partial	None	Died of diphtheria.
55	Van Holst (96)	M	21	o	x	x	x	lt.	Subtotal	?	Considerable peritonitis noted.
56	Vautrin (97)	M	32	o	x	o	x	lt.	Total	Chronic abdominal pain	Cured.
57	Vautrin (97)	M	31	o	x	o	x	lt.	Total	Acute ileus	Ring sutured.
58	Vogt (98)	M	4 days	x	o	o	o	lt.	Total	Vomited everything from birth	No adhesions.
59	Wallace (101)	M	35	o	x	o	x	lt.	Total	Repeated abdominal crises	Whole sac delivered, emptied, sutured.
60	Weil (102)			x	o	o	o	lt.	Total	Diagnosed, appendix abscess	No operation; moribund when seen.
61	Andrews, Edmund	M	37	o	x	o	o	?	Subtotal	Marked adhesions	Vague abdominal distress. Mass.

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TABLE II.—CASES REPORTED PRIOR TO 1906, BUT NOT IN MOYNIHAN'S COLLECTION

		Sex	Age	Pm.	Op.	Strang.	Rec.	Type	Degree	Symptoms	Remarks
1	Abee (1)	M	53	x	o	o	o	lt.	Subtotal	None	Had large congenital cystic kidney.
2	Adeno and Joubelay (2)	....		x	o	o	o	?	Subtotal	None	Classed as mesocolic. Seems typical right duodenal.
3	Aschoff (3)			x	o	o	o	lt?	Large	None	Not typical, doubtful. Had Meckel's diverticulum.
4	Bickersteth (8)			x	o	o	o	lt?	Total	None	Died of other causes.
5	Finley and McTaggart (25)	M	40	x	o	x	o	lt.	Total	Acute ileus	Too sick to be operated upon; died under observation.
6	Finley and McTaggart (25)	Chi	ld	x	o	o	o		Total	None	Died of burns. Case not seen, only specimen.
7	Freeman (27)	M	47	o	x	x	o	lt?	Total	Acute ileus	Bowel resection. Had 8 inches colon in sac.
8	Freeman (27)	M	47	x	o	o	o	lt.	Subtotal	None	Died of cirrhosis of liver.
9	Grawitz (34)	M	35	x	o	o	o	lt.	Total	None	Died of accident.
10	Herbert (41)	M	40	x	o	o	o	lt.	Total	None	Found at routine autopsy.
11	Hueter (45)	M	56	x	o	o	o	lt.	Subtotal	None	Died of pneumonia.
12	Hesser (43)	.....	.	x	o	o	o	lt.	½, small bowel	None	Found at routine autopsy.
13	Manski (57)	.....	..	x	x	x	o	lt.	Total	Acute ileus	Almost irreducible.
14	Mitchell (62)	F	30	x	o	o	o	lt.	Total	None	Shot in heart.
15	Mitchell (62)	F	4	x	o	o	o	lt.	Total	None	Died of burns. (Probably same as No. 6.)
16	Ogle (72)	.....	.....	x	o	o	o	?	Total	Museum specimen	All small gut behind veil. Not recognized as hernia. Called congenital anomaly.
17	Robinson (78)	M	30	x	o	o	o	lt?	12 in.	None	Called congenital enlargement of fossa.
18	Rose (80)	.....	.....	x	x	x	o	lt.	Total	Acute ileus	Peritonitic death. (Possibly a mesocolic hernia.)
19	Schwalbe (87)	.....	..	x	o	o	o	lt?	*	None	Died of other causes.
20	Smith et al. (90)	M	20	x	o	o	o	rt.	Subtotal	None	Died of other causes.
21	Thacher (93)	.....	.....	x	o	o	o	?	Total	Not cause of death	No good description.

* Enormous *empty* sac.

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OBSERVATIONS IN ONE HUNDRED SEVENTY FIVE CASES OF PYELONEPHRITIS[1]

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IN this report, the discussion will include those cases of renal infection caused by organisms other than the tubercle bacillus. No mention will be made of malignancy. In reporting any series of cases, it is well to limit the discussion to some specific entity, and it has been my endeavor to confine this discussion to the etiology, diagnosis, and treatment of pyelonephritis.

It is only since the advent of the cystoscope that the diagnosis and treatment of renal infections have been taken out of the realm of uncertainty and put on a firmly established basis. Before the cystoscope was used, we had to rely on clinical symptoms, on urinalysis, and occasionally on the X-ray findings, and, if the occasion justified it, an exploratory operation was done to determine the exact pathology. With the present armamentarium at our command, an exact diagnosis may be made and it may be definitely determined whether the lesion be in the upper or lower urinary tract.

The sole brief held for this discussion is to emphasize again the absolute necessity for making more careful and guarded diagnoses of intra-abdominal as well as kidney lesions. To rule out the urinary tract in a surgical infection, without making an exhaustive examination of the blood, urine, and, if necessary, the fæces, is to court disaster. No apology is made that this series of cases is seen solely from the urologist's standpoint, or through a cystoscope, as sometimes is whispered along the side-lines, for in every case a careful examination has been made both by myself and Dr. C. S. Lawrence. A report from the laboratory has been studied in every case, including a total leucocyte count, blood smear, hæmaglobin estimation, and an examination of the excreta, if necessary. It is only by collaboration of the general surgeon and urologist that these infections can be solved.

The literature contains enough corroborative evidence to satisfy even the most skeptical, regarding cases of wrong diagnosis. Urinary infections are with us, and just so long as we dismiss them lightly or explore the abdomen without determining the offending organ, then just so long are we going to have a persistent postoperative train of symptoms.

In this series of 175 cases of pyelonephritis admitted to the Lawrence Clinic and treated, 29 per cent gave a history of an intra-abdominal operation with no relief of the pain and other symptoms. Reports bearing out this statement, could be cited from any large clinic, showing that we are too prone to rush in without carefully working up our cases.

The youngest patient seen was 24 months old, the oldest 84 years old. The average age was 39 years. The number of females was 115, while 60 males were affected. One reason why more females are affected is doubtless due to the lack of drainage because the generative organs encroach on the urinary tract. This was recently emphasized in a primipara who entered the hospital complaining of nausea, vomiting, and severe pain in the right side. She had a high temperature and was very toxic. A cystoscopic examination was done. A ureteral catheter was passed to the right kidney and a pyelogram made. The pyelogram showed a constriction at the brim of the pelvis, produced by pressure of the gravid uterus against the pelvic brim, causing an obstruction, which resulted in a marked dilatation of the ureter above that point, producing a hydro-ureter and stasis in the kidney pelvis. An indwelling ureteral catheter did not relieve the symptoms sufficiently to warrant its use for a long period of time, so the uterus was emptied and the patient made an uninterrupted recovery.

ETIOLOGY

The common causes of this disease are:

1. Focal infections, including the teeth, tonsils, sinuses, skin, etc.,
2. Angulations of the ureter;

[1] Read before North Carolina State Medical Society, Asheville, North Carolina, April 18, 1923.

3. Nephroptosis;
4. Infection from adjacent structures;
5. Stenosis of the ureter due to pressure or from external processes, such as gravid uterus, adenoma of the prostate, etc.;
6. Calculi.

It was found that 50 per cent of this series had definite infection in the tonsils demonstrated on removal. It is a common occurrence for a patient to complain of an exaggeration of the kidney symptoms following tonsillectomy. There are cases where the tonsils served only as a portal of entry, not causing any local symptoms, but on removal, cleared up the renal pathology. We have repeatedly removed tonsils which contained pus but causing no pain in the throat, proving that we should be very wary about saying, "Oh, there is nothing the matter with your tonsils." Rosenow has definitely shown that duodenal ulcer, cholecystitis, appendicitis, and many other pathological processes are the result of foci located in the tonsils.

The teeth have been silent but very potent factors in certain of these cases, as 21 per cent were found to have abscessed teeth, demonstrated by X-ray or on examination of the teeth after removal. As high as seven abscessed teeth were seen in a woman with pyelonephritis with no pain whatever referred to the teeth, her infection persisting until they were removed, with no recurrence later. Pyorrhœa pockets alongside the teeth also may initiate this condition. In 7 per cent of the cases we were unable to find any definite focus of infection, possibly obscure lesions in the skin or bone.

The sinuses may also cause trouble though no definite pathology located in the sinuses was seen in any of these cases. The colon, gall bladder, and appendix, may also harbor organisms having a predilection for the kidneys, so that in treating these conditions, all of these potential causes must be eliminated before we can promise a patient a permanent cure.

Angulations of the ureter, ptosis of the kidney, ureteral stricture, and lack of drainage due to pressure from without, may cause pyelonephritis, well illustrated by cases of prostatic adenoma causing back pressure and stasis of the urine in the kidney with systemic absorption. Two of these cases required nephropexy to remove the symptoms, both kidneys being as low as the pelvic brim. Ureteral stricture has been found present in 4 per cent showing that this also must be considered in infections of the upper urinary tract. Hunner maintains that stricture of the ureter is the chief cause of pyelonephritis, but this view is not largely accepted, nor do we accept this as a primary etiological factor.

The methods of infection are usually considered as follows:

1. Hæmatogenous,
2. Lymphogenous,
3. Direct continuity,
4. Ascending along the ureter.

The concensus of opinion is that the vast majority are hæmatogenous, excepting the cases resulting from abnormal position of the kidney, lack of drainage, calculi, etc.

Volumes have been written about the offending organism in this disease but the chief bacteria found are the streptococcus, staphlococcus, and colon bacillus, the two former being found to be the chief sources of infection in this report. The pyogenic cocci are short-lived and usually are not demonstrable in the process they initiate, while the colon bacillus, being a secondary invader, as a rule, causes a purulent discharge, and is easily found in the urine. If a careful search is made, the streptoccus may also be found, though the colon bacillus usually outgrows and literally crowds it out. What is usually seen is the end-result and not the exciting cause. The colon bacillus usually is found where the infection is not blood-borne.

DIAGNOSIS

I think it is safe to say that the majority of surgical infections can be either definitely proven to be in the kidney or not. This being true, then it rests with us, as diagnosticians, to eliminate the kidney before exploration of the abdomen is justified. While 74 per cent of this series complained of pain in the affected side, pain and tenderness are unreliable signs. Radiation and juxtaposition of the abdominal contents make these signs unreliable. Muscle

spasm is of significance, and as a rule, is present in peritoneal infections. The temperature in acute kidney infections is usually higher with a lower pulse rate and frequently a chill at the onset. The leucocyte count is higher where the peritoneum is involved, rarely as a rule, in kidney infections, being over 15,000 to 18,000 white cells. Nausea and vomiting are usually present in abdominal infections, less so in kidney ones. Too much dependence should not be put on localization of an abdominal mass by palpation. The following case illustrates this point:

A man, age 33, entered the hospital March 22, 1922, complaining of a tumor mass in the left hypogastric region, freely movable and tender on pressure. The mass was the size of a large grapefruit, and could be freely moved into any other part of the abdomen. The history revealed the fact that he fell off of a wagon striking on buttocks, temporarily stunning him, but he was able to get up in a few minutes and resume his occupation. He had no further symptoms until 3 weeks ago, when the tumor had become so large that it interfered with his work. Physical examination was made but on account of the difficulty in localizing this mass, cystoscopy was done, and a pyelogram made of the kidney, which showed the mass to be attached to the lower pole of the kidney; on removing the organ it was found to be a hæmorrhagic cyst within the capsule. His recovery was uneventful.

Of this series, 13 per cent had postoperative pyelonephritis showing that it is quite common as a sequela of pus in the abdomen and also that it is frequent that these two conditions may co-exist (at the same time) and one serve as the cause of the other, and only by relieving both the infections can we stop this vicious circle. Of the 175 cases, pain in the affected side was present in 74 per cent, while dysuria and frequency was present in 50 per cent, varying from a slight frequency to very urgent tenesmus. Hæmaturia was seen in 16 per cent while 10 per cent had pain referable to other organs. Seventy-one per cent had bilateral pyelonephritis, 20 per cent were on the right side with nine on the left. Five cases had atrophic pyelitis, with marked diminution of the pelvic capacity. This condition is very obstinate. This process is diagnosed by a pyelogram after it is found that the pelvis does not hold as much as it should, i.e. from 5 to 8 cubic centimeters.

In any case where doubt exists, it requires but a few minutes to pass ureteral catheter to the kidney and definitely establish the status of the kidneys. Preliminary narcotization and gentleness in passing the instrument will obviate most of the pain incident to cystoscopy; so let me urge you to avail yourself of this aid in helping to solve every doubtful case.

A diagnostic point of much importance, is hammer percussion over the suspected kidney, pain being elicited in 90 per cent of the cases, varying with the degree of involvement of the kidney. In the diagnosis of appendicitis, beware of chronic pain in the right side with no acute flare-ups, also consider carefully a diagnosis of appendicitis made with the X-ray with no outstanding abdominal symptoms. Urinary findings may be both helpful and misleading; a single negative urinalysis may lull one into a false sense of security because of temporary lack of drainage caused by a plug of mucus, so that whenever possible a 24-hour specimen should be examined.

In a recent paper by the writer, attention was called to the fact that, in a series of 1000 autopsies, 20 per cent showed definite inflammatory changes present in the kidney, and of more significance was the fact that they were entirely overlooked in the determination as to the cause of death. Rather a high percentage of error.

Eight patients in this report passed stones as a result of cystoscopic manipulations. Twenty per cent of these stones were overlooked by the X-ray. Braasch, Cabot, Hall, and others report from 9 per cent to 20 per cent of ureteral stones not demonstrable by the X-ray, so that it is necessary in all cases where there are red blood cells in the urine to pass a wax-tipped catheter to the kidney and on withdrawal, to examine it for scratch marks. Keyes has devised a simple technique for passing a waxed bulb through the ordinary cystoscope, and is of the opinion that calculi may be found by this method that would otherwise escape notice. The term "essential hæmaturia" has given way to scientific diagnosis, and if the case be carefully worked up, we will find it unnecessary to hide our ignorance behind this meaningless term.

McNider, Payne, and others have shown that many of the so-called "essential hæmaturias" were the result of infections about the collecting tubules, resulting in scar tissue which interfered with the return blood supply causing congestion and rupture of the papillæ with hæmorrhage.

This pathological process may be the primal factor where tumor, calculi, infections, stricture, pyelitis granulosa, trauma and tuberculosis are ruled out. With the aid of a pyelogram or ureterogram together with the renal function and blood retention tests, a positive diagnosis can usually be made.

Several years ago John B. Murphy stressed the importance of obtaining an accurate history and making careful examination, paying close attention to the sequence of the symptoms as they appeared. The careful surgeon will correlate and make his deduction from the above enumerated findings and if this is done, there will be a great reduction in the number of cases of mistaken diagnosis and unnecessary abdominal explorations.

TREATMENT

In attempting to clear up renal infections, several factors must be considered. Conservative treatment in the past has not properly solved the problem, *per se*, as the etiological element was not considered. While we all advocate rest in bed, fluids, urinary antiseptics, and dietary measures, we must not lose sight of the fact that in many instances, the patient's life is at stake, and recent experience has taught us that more radical procedures are indicated and necessary. The treatment will, therefore, include:

1. Supportive measures,
2. Elimination of focus,
3. Cystoscopy,
4. Correction of any mechanical defects.

Supportive treatment will include hospitalization, with rest, forced fluids and the administration of some urinary antiseptic, and if necessary, a sedative, for the pain incident to the passage of a plug of mucus through the ureter is just as severe as that caused by a stone, for it is the sudden blockage of the ureter with distention of the kidney pelvis that causes such intense pain. Mixed vaccines in certain cases, may prove helpful but should not be depended on entirely. We have found that failure to eliminate the causative agent will fail to cure the patient permanently, and this fact is well illustrated by the fact that several patients who refused to have their tonsils removed even though the kidney was repeatedly lavaged, still complained of their symptoms, but later, after removing the cause, they promptly got well.

I recall a case where it was necessary to withdraw seven abscessed teeth before the patient got entirely well. Frequently, because patients do not have toothache or tonsillitis, it is hard to convince them of the necessity of an X-ray of the teeth and perhaps the extraction of several silent abscessed teeth or removal of tonsils to cure them.

It requires all the patience of the physician at times, to handle some of these patients who say, "Why Dr. So and So said that tooth is as sound as a dollar," when we tell them it should be extracted or, they say, "Dr. So and So said my tonsils were all right,"—a very broad statement for a physician to make from a superficial examination of the throat. More than one prominent otolaryngologist has said that he had never seen a normal pair of tonsils. If the focus be elsewhere, diligent search and elimination will reward the effort.

With the aid of the cystoscope, the exact pathology can usually be determined, and by passing a catheter to the kidneys, surgical drainage is established just as much as a tube drains an abscessed appendix. It has been found that silver-nitrate is most efficacious in clearing up pyelonephritis. It does not merely localize itself in the pelvis, but Weld has shown that this antiseptic penetrates the tubules as far as the glomeruli, sterilizing the entire tract. Mercurochrome gives fairly good results but silver-nitrate causes an erosion of the epithelial layers of the pelvis, thus allowing sterilization of the underlying tissues. The pelvis should be distended to the point of fullness, not pain; otherwise, the results are not so beneficial. Experience will obviate the necessity of using any special apparatus to determine the pressure of the injected fluid; an ordinary 20 cubic centimeter Luer syringe will answer all purposes.

In conditions where hæmaturia is present, 5 per cent silver-nitrate may be used with impunity, and will usually stop the bleeding unless the cause is specific. If a stenosis of the ureter is present, it will be necessary to dilate it and establish free drainage. We make it a practice to dilate all ureters to No. 11 F., thus insuring free drainage. If present stricture of ureteral orifice may be relieved by cutting it with scissors and then dilating it.

In correcting mechanical defects, it is necessary to consider such conditions as ptosis of the kidney causing kinks in the ureter, pressure on the ureter by an abdominal viscus, adenoma of the prostate, etc.

In selected cases of hydronephrosis a plastic operation on the sac may benefit certain cases a great deal; occasionally in pyelonephritis of pregnancy it will be necessary to empty the uterus, but an indwelling ureteral catheter should be tried and, if necessary, continous pelvic lavage instituted.

In this series, only one surgical kidney was seen, an acute fulminating streptococcus pyonephrosis, which required nephrectomy. By draining the kidney with a catheter and promptly eradicating the cause, we will, in the majority of cases, save the patient an operation. Our records show 94 per cent cures, where patient consented to complete eradication of focus and continued treatment until specimen was free of pus and culturally negative.

CONCLUSIONS

1. A very careful examination of the urinary tract should be made before one is justified in opening the abdomen.

2. Of this series 29 per cent had an abdominal operation which did not relieve the patient at all.

3. Pyelonephritis is being constantly overlooked as well as dismissed lightly by the medical profession, and as long as this is true we will continue to fail to cure a large number of cases.

4. A diagnosis can usually be made by an examination of a 24-hour specimen of urine and, if necessary, by a cystoscopic examination, ureteral catheterization, and by pyelogram if in doubt.

5. The treatment consists not in conservative methods but in the elimination of the focus of infection, lavage of the kidney pelvis, and dilatation of the ureter with the correction of any mechanical defects which may be present.

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UNILATERAL URETERAL INJURIES[1]

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TRAUMATIC injuries of the ureters are exceedingly rare; operative wounds relatively common. The literature of ureteral wounds has developed within comparatively recent times in keeping with the rapid development of modern surgery. The Wertheim operation for cervical cancer has been productive of more ureteral surgery than any other operative procedure, probably not excluding intentional injuries done during the course of bladder operations.

Several instances of ureteral injury have come to our attention during the past 2 years, each one of which will serve as a text for the discussion of an important phase of our subject. So rarely does the surgeon meet with these cases that he must rest content with a knowledge of the experience of others and bide that time when this knowledge will aid in the difficult solution of the problem presented by a ureteral injury occurring in his own practice.

FREQUENCY

The majority of traumatic wounds of the ureter involve the lumbar or abdominal segment: accidental or operative wounds involve chiefly the pelvic portion of the tube. In 1902, Maubert collected 30 cases of surgical injury of the ureters; Oeconomos in 1921 found 159 cases reported; T. S. Burr mentions a series of 630 hysterectomies for carcinoma in which the bladder was injured 19 times, a single ureter 10 times, the bladder and one ureter, 3 times, and both ureters one time; Sampson reported 32 injuries occurring in 1095 pelvic operations, 19 of which complicated operations for uterine cancer; Kayser collected 29 cases of ureteral injuries, 26 of which complicated the Wertheim operation.

This writer quotes Wertheim as having had 49 (10 per cent) of ureteral injuries in a series of 500 hysterectomies, of which only 9 were intentional.

Reuben Peterson's paper gives the detailed account of 72 cases of uretero-ureteral anastomosis, the majority of which were primary repairs of surgical injuries. In a paper by the author in 1922, there were tabulated 24 instances of bilateral ureteral injury to which may be added 4 additional cases, one reported by Crabtree, another by Laws, while Dr. E. E. Montgomery and Dr. Edward Schumann have each had a case of bilateral ureteral ligation. Dr. Montgomery's patient was reoperated upon when it was found that the ureters had been ligated and cut. Bilateral ureterovesical anastomosis was done and the patient survived for about a year when she died from recurrent carcinoma. Dr. Schumann's case is most remarkable in that the patient has survived double ureterovesical anastomosis and is apparently well 12 years after operation. Barney, in 1910, could collect only 20 authenticated instances of the intraperitoneal injury of one ureter.

The foregoing figures are impressive of the fact that while ureteral injuries are not uncommon, it is likely that in many more instances the injury is not reported, or that the patients die without recognition of ureteral injury as the cause.

CLASSIFICATION

Bilateral:
- Traumatic
- Operative (accidental)

Unilateral:
- Traumatic
- Operative (accidental)

Bilateral traumatic injuries—none reported in literature.

Bilateral operative (accidental) injuries.
- a. Bilateral ligation
- b. Kinking by ligatures
- c. Occlusion by vaginal clamps
- d. Occlusion by exudate following Percy cauterization
- e. One ureter severed; other ligated
- f. Segment removed from one ureter; other occluded by kinking
- g. One ureter kinked, other ligated.

Unilateral traumatic injuries.
- a. Stab wounds
- b. Gun-shot wounds
- c. Subcutaneous injuries

Unilateral operative (accidental) injuries.
- a. Ligation
- b. Unilateral division-intra-or extraperitoneal injury
- c. Excision
- d. Instrumental rupture (catheter)
- e. Crushing with clamps
- f. Perforation with needle
- g. Lacerations, contusions, denudation.

[1] Read before the Philadelphia Urological Society, February, 1923.

UNILATERAL TRAUMATIC INJURIES

Subcutaneous injuries of the ureters may be classified among the curiosities of surgery. Morris collected 24 cases of which he considered only 3 to have been verified; 4 were classified as probable and 5 as possible; 12 were rejected as not even probable. One of the verified cases, that of MacKenzie, was intraperitoneal. Keyes accepts MacDonald's case as authentic.

The following case history is submitted, not with the claims of absolute authenticity, but in the belief that we were dealing with lacerations of the ureter complicating fracture of the pelvis.

Unilateral traumatic injury of the ureter complicating fracture of the pelvis, with lacerations of the prostatic urethra.

Adult male, admitted to the Methodist Hospital of Philadelphia on the surgical service of Dr. James Baldwin in 1922. Seen in consultation with Dr. Baldwin some hours after the accident. Patient had passed some bloody urine and there was slight spontaneous bleeding from the urethra. The patient's condition was satisfactory. Cystoscopic examination showed lacerations in the prostatic segment of the urethra with considerable bleeding. Blood was seen issuing from the orifice of the left ureter. The right ureter was patulous and apparently normal. The left ureter was obstructed at the level of the sacro-iliac joint and manipulations of the catheter seemed to increase the bleeding. It was impossible to insert the catheter beyond this point of obstruction. There were no symptoms pointing to renal injury so that it was decided to treat the case expectantly. Subsequent X-ray studies showed fracture of the ilium extending through the left sacro-iliac joint and fracture of the descending ramus of the pubic bone. The patient was kept under observation by Dr. Baldwin and the writer during an uneventful convalescence. No further urological examinations were made.

F. T. Brown reports a case of subcutaneous rupture of the pelvis of the ureter which is, so far as we know, absolutely unique in surgical writings.

F. T. Brown. Traumatic rupture of the pelvis of the right ureter.

Boy, aged 9 years, admitted to the hospital with the history of having been struck by a car. There seemed to be an injury on the left iliocostal region. Several ounces of bloody urine were removed by catheter. He recovered, but a tumefaction appeared in the right loin which was thought to be a hæmatoma. After 3 weeks he was discharged from the hospital but reapplied for admission after several days complaining of pain in the right loin, swelling of the abdomen, and vomiting. There was bulging in the right flank and a fluctuating mass was felt below the right costal margin anteriorly. Cystoscopy showed obstruction of the right ureter ¾ inches from the bladder. The cause of this obstruction was not determined. An incision was made in the flank and 36 ounces of bloody urinous fluid was evacuated. The kidney was apparently normal. The operation was followed by a persistent urinary fistula and 16 days later the kidney became tender and systemic symptoms appeared. Nephrectomy was done, and on examination there was found a rent in the pelvis of the ureter ¼ inch in length and situated about 1½ inches from the kidney.

Gunshot and stab wounds of the ureter are likewise extremely rare. It is a surprising fact that the surgery of the war has added but little information on the subject. Many ureteral injuries were doubtless overlooked when in association with extensive and fatal visceral injuries, and many also have no doubt gone unreported. According to Oeconomos, only 15 cases have been described and none of these as bayonet, sword, or dagger wounds.

In calling attention to the rarity of war wounds of the ureter, Oeconomos takes occasion to mention the remarkable case of Zaayer in which the ureter was punctured by an iron picket. The patient, a child of 9 years, fell upon an iron picket fence, one of the points entering the abdomen and perforating the ureter. The extravasated urine came away through the abdominal wound without signs of peritoneal infection. Nephrectomy resulted in complete cure.

In Vaughn's classical case of gunshot wound of the ureter, the symptoms of peritonitis appeared after a week, but at operation no visceral injury was found. Thereafter urine discharged from the abdominal incision and from the wound of exit of the bullet in the back. Three months later the obliterated lower end of the ureter was exposed, and after dissecting free the upper dilated segment, a ureterovesical anastomosis was made successfully. Barney's patient had four perforations of the small intestine in addition to complete severing of the ureter. Death followed as the result of peritonitis, but at autopsy the peritoneal cavity was free from urine, nature

having sealed off the ureter. There are other cases of stab and gunshot wounds of the ureter scattered through the literature, the majority of which have been quoted again and again and need not be discussed here.

With this brief reference to traumatic injuries, we will proceed with the discussion of the far more important subject, namely operative injuries of the ureters.

ETIOLOGY

Operations on the pelvic organs in the female are the most common, but by no means the only source of accidental ureteral injuries. Congenital or acquired malposition of the ureters offers a predisposition to injury during operation in areas so remote as the hernial orifices.

Ross and Taylor discussed this particular accident several years ago and reported an interesting case. Corliss in 1904 collected 11 cases, 6 of which were inguinal and 5 femoral. The hernial sac usually contains a portion of the bladder wall as well as one ureter, usually the right. The latter is almost invariably dilated as the result of congenital atresia of the orifice, the dilatation preceding its displacement in the sac. The dilated thin walled or badly infected ureter contained in the hernial sac is usually opened by the surgeon in the belief that he is dealing with a diverticulum of the sac, a cyst of the cord, or a mass of enlarged veins. The ureter usually drains an infected or functionless kidney and calls for nephrectomy in the majority of instances.

Rupture of the ureter by the ureteral catheter probably occurs more frequently than the reported cases would lead one to believe. The normal ureter is extremely resistant to traumatism, but undue pressure with the catheter at the site of a stricture or area of ulceration due to stone may easily direct the instrument into the retroperitoneal space or even into the peritoneal cavity Noble removed a ureteral catheter from the peritoneal cavity and sutured the rent in the ureter. The catheter had been used as a guide in attempting to remove a ureteral stone. During the extraperitoneal operation, the peritoneum was opened accidently and the catheter was found in the peritoneal cavity. The patient recovered.

Vaginal hysterectomy has had its toll of injured ureters, but more as the result of crushing by clamps than by ligation. As long ago as 1895, Tuffier was able to collect 40 cases of ureterovaginal fistula following this operation.

Ureteral occlusion has followed the application of the Percy cautery to the malignant cervix. Ureteral injury has never, so far as we know, been attributed to the action of radium on cervical cancers.

Voluntary ureteral injury is now done whenever the operator feels that the exigencies of the case demand it, and the success of anastomotic operations has removed in large part the fears concerning the final outcome.

When wounded inadvertently, the ureteral wound is likely to escape detection during the primary operation but if the discovery is made, repair may be done in many instances with no greater difficulty than in cases of intentional injury. The majority of accidental injuries, however, are not discovered at the time of operation and with the development of complications, the necessity for operative repair arises. While the late results of ureteral injury have served in some measures to teach us the proper method of dealing with injuries discovered early, nevertheless each case remains more or less a law unto itself.

Under all circumstances, much depends upon the site and nature of the injury, the previous state of normalcy of the kidney and ureters, the gravity of the primary operation, the condition of the patient, the time that has elapsed since the primary operation, whether the injury is unilateral or bilateral, and whether the injury is intraperitoneal or extraperitoneal. Bilateral injuries other than occlusion are rare; these we have discussed elsewhere and will limit our remarks at this time to unilateral injury.

THE SITE AND NATURE OF THE INJURY

With a few rare exceptions, accidental wounds of the ureter are so situated that anastomosis of the ends of the tube or intra-

vesical implantation is feasible, though not necessarily expedient.

The vast majority of such injuries are brought into an extraperitoneal position with the peritoneal repair incident to the primary operation and can be classified as intraperitoneal only when urinary extravasation occurs into the peritoneal cavity. Intraperitoneal injury of one ureter is known definitely to have occurred in 20 instances, most of the patients having recovered with the development of fistula through the original abdominal incision. Barney has called attention to the fact that the peritoneum of man occupies a place midway between the carnivora and the herbivora in its reaction to sterile urine, in that like the herbivora it shows a marked resistance to the irritating effects of extravasated urine. In the absence of pre-existent ureteritis or pyelonephritis, intraperitoneal division of the ureter rarely leads to generalized purulent peritonitis, the ureter quickly becoming occluded by blood clots and exudate; or, if leakage continues, the urine finds exit at the abdominal incision. Ureterovaginal fistulæ commonly follow ureteral injuries, but these must be looked upon as extraperitoneal in the majority of instances.

The nature of the injury varies from simple contusion, which one could scarcely hope to avoid in hysterectomy, to the tearing away of large segments of the tube. This latter occurred together with traumatic rupture of the iliac artery and vein while Werder was attempting the removal of a 12 pound sarcoma of the ovary.

The various operative ureteral injuries may be tabulated as follows:

a. Partial section,
b. Complete section,
c. Removal of segments of various lengths,
d. Denudation,
e. Destruction of nutriment vessels and nerve supply,
f. Ligation,
g. Crushing with clamps.

The accumulated clinical and experimental data relative to ureteral injuries lead to certain therapeutic generalizations that will probably stand the test of time. In the primary repair of the completely severed ureter, where restoration of the continuity is possible, the choice lies between uretero-ureteral and ureterovesical anastomosis. In adopting the former, one presupposes the possiblity of end-in-end anastomosis which, as Peterson has shown, is vastly superior to all other methods. I think it is safe to say that when this method is impracticable, uretero-ureteral anastomosis should be discarded in favor of some other procedure. Furniss champions bladder implantations, and denies the allegation that the new ostium soon contracts with destruction of the kidney. He reports two cases in which the functional results were excellent, in one instance the attendant pelvic distention decreasing. Furniss advocates the method in cases of double ligation if, after removal of the ligatures, the vitality of the ureteral walls seems to be impaired. Kroenig reports two cases of primary double anastomosis in one of which both kidneys were functioning well 2 months after operation. The successful cases of bilateral ureterovesical anastomosis of Montgomery and of Schumann have been mentioned.

Two additional instances of late double anastomosis for ureteral injury have been recorded; Werder's patient developed a recurrent fistula which was corrected by colpocleisis; Pinkham's case resulted in a primary success.

Unilateral ureteral injuries discovered during the primary operation which cannot be corrected by anastomosis operations are best handled by ligation of the proximal segment, provided the ureter is not infected and provided also that there is a healthy kidney on the opposite side. When the opposite kidney is functionally poor and anastomosis of the severed tube is impossible, the upper segment must be implanted in the bowel or its end brought to the skin surface. In the event that the ureter is badly diseased or drains a badly infected kidney, an immediate uretero-nephrectomy is indicated, provided the condition of the patient warrants it; otherwise the end of the ureter should be brought to the skin surface and nephrectomy performed later. This is a safer procedure than ligation of an infected ureter. The above rules are based on the considerable clinical

experience of Judd and many others, not only with accidental ureteral injuries but in bladder surgery, in which the disposition of one ureter is a frequent problem.

Anders Peterson reports 17 clinical cases of unilateral ureterovesical anastomosis of which 4 were examined later and the ureter was found to function normally. Kroenig reported 9 cases operated upon for ureterovaginal fistulæ with bladder implantation of the ureter. These patients were cystoscoped from 5 months to 1½ years after operation and in 5 the transplanted ureter functioned normally, while 2 showed stenosis with slight hydronephrosis. Peterson did 24 dog experiments either by the Coffey, Stiles, Mann or Furniss technique with 80 per cent of successes and 20 per cent of failures from stenosis, pulling out of the ureters and infection. Wertheim is credited by Kayser with 100 per cent of success in 7 primary operations and with four successes out of five attempts at the repair of ureterovaginal fistulæ by ureterovesical anastomosis. From the Mayo clinic comes the report of 21 clinical cases of ureterovesical implantation, 17 of which were cystoscoped from 18 days to 4½ years after operation; in 5 the kidney had ceased to function, but in all of these the ureter had been anastomosed under great tension. Eliminating these, the normal kidneys were 75 per cent, the fair functioning kidneys, 25 per cent.

There are four deaths in the series from operation—all cancer cases. It is advised that the ureter be ligated when great tension is necessary to bring the bladder and ureter together; otherwise anastomosis may be done with every chance of success. Judd believes it is a safer procedure to ligate a hydro-ureter than to implant it.

One must conclude from the data at hand that ureterovesical anastomosis is a satisfactory procedure in selected cases.

Ligation of an uninfected ureter may cause the silent death of the kidney; it may cause pain demanding nephrectomy; it may give rise to secondary infection of the kidney, or ureteral necrosis may occur at or above the site of obstruction, giving rise to fistula deformation or peritonitis, or in rare instances the ureteral lumen may be restored as a result of absorption of the catgut before kidney destruction has taken place. Barney's figures indicate that ureteral ligation is not so innocous a procedure as some maintain. In one of his cases of single ligation the patient died after 36 hours from uræmia with urinary suppression. In a similar case reported by Robinson, the patient recovered after decapsulation of the kidney on the non-obstructed side. The writer has recently seen a case of hydronephrosis following unilateral ureteral injury in consultation with Dr. Damon Pfeiffer, of Philadelphia. This patient was referred to Dr. Pfeiffer for examination on account of pain and a mass in the right kidney region. The patient's husband, a physician, stated that a vaginal hysterectomy had been performed 14 years before. Immediately succeeding the operation, which was done by the clamp method, considerable pain was felt in the region of the right kidney. This pain persisted until the clamps were removed. The convalescence thereafter was uneventful and no abnormality of the kidney was suspected until some years later when an attack of acute infection again directed attention to this organ. At examination it was found that the ureter was obstructed at a point near the bladder wall, and that the kidney was entirely functionless.

Of Sampson's 10 cases of unilateral ligation, 6 recovered, one with hydronephrosis, the other 5 with renal atrophy. Barney failed to produce reflex anuria after single ligation in 36 dog experiments. In 21 per cent of the human cases an early decrease followed by a rapid increase in urinary secretion was noted. In two instances hæmaturia followed the ligation but was rapidly recovered from. Slight pain and tenderness in the renal area followed ligation in 26 per cent, necessitating nephrectomy in one instance. Renal infection occurred in 7 (15 per cent), and it was necessary to do a nephrectomy in every instance.

Barney states that the primary mortality of unilateral ureteral ligation is 17.8 per cent, and this together with the considerable morbidity succeeding the operation definitely contra-indicates the procedure in Barney's

opinion. The final answer to the question remains for the future to decide.

There is a similar difference of opinion regarding the changes that occur in the human kidney after ureteral ligation and also to some extent in the kidneys of experimental animals. Beer concluded after experiments on 60 dogs that aseptic ligation of the ureter leads to primary hydro-ureter and hydronephrosis, and after about three weeks shrinkage and atrophy of the sac begins; that after three or four months the kidney is represented by a small fibrous mass, but that in the presence of infection a large hydronephrotic sac results. G. D. Scott in 30 experiments found that typical hydronephrosis results in every instance, the degree depending upon the duration of the obstruction. He further states that complete permanent obstruction produces hydronephrosis more rapidly than incomplete obstruction. Guyon is in agreement with Beer having, found atrophy to succeed slight temporary distention. Cohnheim is of the same opinion. Pearce in experiments on dogs, Bainbridge working with cats, and Amos in ligations on rabbits and guinea pigs, produced hydronephrosis in practically every instance.

With experimental results so widely at variance, one could scarcely expect to find unanimity of opinion regarding the sequence of events in clinical cases.

Having discovered ureteral ligation at the time of the primary operation, the ligatures should be removed, and in 5 such cases reported by Sampson the convalescence was uninterrupted. In the absence of demonstrable injury due to the ligation which would promise future necrosis, deligation is unquestionably the proper procedure, notwithstanding that necrosis has been known to occur in certain instances. T. S. Burr reports a case of immediate deligation in which a vaginal fistula appeared after 3 days but closed spontaneously in several months.

Unilateral ligation discovered hours or days after the primary operation in the absence of fistula or other symptoms presents the most difficult of surgical problems. In the absence of symptoms and with a normal kidney on the opposite side it seems to me that honesty demands a frank statement of the accident, but that sound judgment would dictate inactivity.

Several cases of spontaneous rupture of a ligated ureter are recorded, one by Frankel, the other by Blumenfield. In Frankel's case the ureter had been sectioned and ligated; the ligatures cut through and the patient died of peritonitis. Blumenfield tied the ureter unintentionally and on the ninth day the ureter ruptured just above the point of ligation, causing fatal peritonitis.

Clinical symptoms arising from unilateral ligation are chiefly referable to the kidney and are caused for the most part by infection. Total ureteral obstruction may be due, not to encircling ligatures, but to inflammatory swelling or to kinking from ligatures placed in proximity to the duct. In these cases the problem is not the restoration of continuity of the urinary tract but the treatment of complications. In the majority of instances nephrectomy is necessary on account of infection of the kidney. In case of double ligation, the removal of the ligatures is the method of choice.

Traumatic interference with the nutrition of the ureter leading to necrosis is a more serious accident than ligation or even sectioning of the tube, provided these accidents are discovered at the primary operation. Crushing with clamps is likewise a serious accident. Furniss accidently clamped the ureter in two cases, the clamps remaining in position 7 or 8 minutes. In one a fistula developed in 8 days, in the other in 20 days. In both instances, the ureter had been dissected free for a distance of 3 centimeters at the site of application of the clamps. This is considered a contributing factor in necrosis to the extent that Furniss considers it an indication for immediate ureterovesical anastomosis. Sampson, however, mentions four similar cases which recovered without complications; in one case 17 centimeters of ureteral catheter were left in the ureter and the patient died after 7 days; in another instance an indwelling catheter was crushed by the clamp but the fragment was removed through a slit in the ureter and the patient recovered without complications; in still another case, a ureterovaginal fistula

developed but closed spontaneously in 3 weeks. In three cases the ureter was both clamped and ligated but released during the operation; one developed an obstruction which was relieved by catheterization; the others recovered without complications.

Harrington crushed the ureter in dogs with a Kocher artery forceps for from 1 to 30 minutes and then replaced the ureter behind the peritoneum; no leakage of urine followed.

Crushing of the ureter during labor is an infrequent cause of ureterovaginal fistula.

One is quite unjustified in drawing conclusions from such insignificant data, but our feeling is that the surgeon should be guided by the appearance of the crushed segment. If the tube is pulpified, natural restoration would scarcely be expected and anastomosis would be in order. In all cases some provision should be made for drainage, preferably through the vagina.

In one of Graves' cases in which the ureter was almost completely severed, he ligated the proximal end without evident interference with the patient's convalescence.

Secondary necrosis of the ureter following pelvic dissection is a rare complication. In experimental animals considerable trauma can be inflicted without secondary necrosis as shown in the experiments of Harrington and of Stewart and Barber. In 7 of Wertheim's clinical cases the sheath of the ureter alone was injured and two developed urinary fistulæ. Gaston Torrance reports a case of ureterovaginal fistula following a Wertheim operation in which the ureter had been dissected up to the pelvic brim but not incised. The condition was corrected by ureterovesical anastomosis. In the following case the inference is that the ureter had been pricked by a needle or possibly the wall partly included in a ligature. We have no explanation to offer of the closure of the fistula after catheterization but the case is not unique.

Unilateral ureteral injury complicating hysterectomy; ureterovaginal fistula; spontaneous closure of fistula following ureteral catheterization.

Mrs. H. M., 50, admitted to the Methodist Hospital of Philadelphia, service of Dr. Norris. Diagnosis: chronic metritis and endometritis. Operation: October 26, 1921, panhysterectomy—bilateral salpingo-oophorectomy. Small para-ovarian cyst on right side removed. Pathological diagnosis: chronic metritis and endometritis—Richardson. Postoperative: The operation was not difficult and the postoperative course was uneventful until the fourth postoperative day when the patient complained of a watery discharge from the vagina. During the first few days the output of urine was normal in quantity and quality. After the development of the fistula, the output of urine from the bladder was diminished in quantity but it was at no time abnormal either microscopically or chemically.

Examination November 15, 1921, showed no communication between the vagina and bladder or urethra.

Cystoscopy, November 28, 1921 (Dr. Herman). Bladder mucosa normal. No fistulous openings found. The left ureter obstructed to all catheters at a point 3 centimeters from the bladder, but the catheter drains normal appearing urine in a continuous flow. Right ureter patulous; normal urine in normal spurt.

Indigo-carmine (15 cubic centimeters) injected intravenously. Intense blue urine from the right catheter in 3 minutes; moderately blue urine from the left catheter and from the vagina in six minutes. After a period of 20 minutes a catheter was placed in the bladder and the urine obtained was not discolored.

Cystoscopic diagnosis: ureteral fistula (left) communicating with the vagina. The left ureter is obstructed to catheters but not to flow of urine at point 3 centimeters from the bladder. It seems likely that a small opening was made in the ureter or the latter injured at the time of operation, possibly by a needle.

Postoperative: The day following catheterization the flow from the vagina ceased and never recurred.

December 3, 1921. Phenolsulphonephthalein first hour—30 per cent: 2nd hour—15 per cent.

December 3, 1921. Discharged.

In all cases where the integrity of the ureteral wall has been jeopardized, drainage should be instituted, care being taken to avoid placing gauze in positions approximating the site of the ureteral injury.

In discussing the treatment of unilateral ligation discovered after operation and without symptoms, we advised inactivity for the reason that operative repair has a considerable mortality and with a normal kidney on the opposite side the patient's expectations of life are not seriously impaired or curtailed.

If implantation is to be considered, the longevity of the renal parenchyma in states of complete obstruction is of prime importance. Nature is most tenacious of renal function which may continue in dogs after 36 days of complete obstruction. Harrington found that

after 3 weeks' occlusion sufficient parenchyma persisted to justify implantation into the bladder. Barney mentions three cases of unilateral obstruction, in one of which the ureter was released after 6 days with restoration of normal function; in a second case the obstruction continued for 10 days and there was considerable hydronephrosis but the kidney continued to secrete clear urine for years after operation; success followed deligation in a third case after 5 days. Barney concludes that ureteral obstruction may persist for 10 days without material injury to the kidney, while Johnson has shown that the renal function may be restored to the normal in dogs whose ureters have been obstructed for no longer than 2 weeks. In Caulk's case of bilateral obstruction of 8 days' duration, nephrostomy resulted in cure.

From the foregoing it is evident that promptness in relieving the obstruction is of vital importance in these cases.

Excluding cases of ureteral injury discovered at the time of their receipt, the vast majority come to the attention of the surgeon because of postoperative complications of which the most important are urinary fistulæ. We have already quoted Barney to the effect that the primary mortality in unilateral obstruction is 17.8 per cent and that infection of the kidney necessitating nephrectomy occurs in 15 per cent.

It is impossible to give the comparative incidence of urinary fistulæ following the several types of injury but ligation is perhaps the rarest cause of fistula. There were 18 fistulæ in Barney's series of 29 cases of intraperitoneal injury of one ureter, most of them being of the uretero-abdominal variety, but of the total number of ureteral injuries, ureterovaginal fistula is the most common complication.

The development of a fistula may be the first indication of the ureteral injury or there may be preliminary symptoms referable to the kidney. Anuria from reflex suppression is unusual. The fistula developed in from 7 to 18 days. In Crosbie's case a mass appeared above the pubis 2 days after hysterectomy, and puncture of the posterior vaginal cul-de-sac brought a gush of urine. Subsequently, a right ureterovaginal fistula was corrected by nephrostomy and uretero-ureteral anastomosis.

DIAGNOSIS

The cystoscopist will find little trouble in localizing the site of the ureteral injury, nor will there be difficulty in locating the fistulous opening which occupies the vault of the vagina as a rule on the injured side. Not only is the ureter usually obstructed at the site of the injury but if the latter is at all extensive, the lower segment lacks peristaltic action and the sphincter is more or less paralyzed. The ureter may be obstructed to catheters at a certain point, but the distal segment and the ureteral sphincter are seen to function, while dyes injected intravenously appear in the bladder by way of the involved ureter, as happened in one of our cases. This indicates partial necrosis of the ureter and is of good prognostic significance.

After the preliminary examination in these cases a catheter is placed in the healthy ureter and plug of cotton in the vaginal vault. An injection of indigocarmine is given and its appearance is watched for from the catheter, from the involved ureter and from the fistulous opening. Prompt appearance of the drug from the catheter in the healthy ureter and delayed but equal appearance from the opposite ureter and from the fistula is diagnostic. If the suspected ureter shows no elimination there can be no question of the involvement of that side. Laws has reported what he believes to be an exception to the above rule. His patient had openings at each angle of the vaginal vault. The right opening was draining freely but no urine came from the left one. It was found that the right ureter was patulous and the left ureter obstructed at 4 centimeters. Clear urine was obtained from the right kidney, cloudy urine from the left ureter. Indigocarmine appeared in the vagina in 6½ minutes and immediately afterward from the right kidney and then from the left. On injecting indigocarmine into the right catheter it appeared in the vagina. This he looks upon as an exception to Kelly's rule, namely that the vaginal fistula is on the side of the obstructed ureter. It is possible that colored fluids injected into

the pelvis of one kidney might be absorbed and eliminated by way of the opposite kidney.

Having found the location of the fistula it becomes necessary to ascertain the functional state of the kidneys and the presence or absence of infection, for upon this determination depends the treatment. The longer the fistula has persisted the greater the degree of renal destruction as a rule, since all fistulous ostia have a tendency to contract and cause renal distention. Infection is of evil significance although not necessarily precluding transplantation operations.

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THE TRANSPERITONEAL CERVICAL CÆSAREAN SECTION[1]

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THE term transperitoneal cæsarean section is a confusing one since, at the present time, it may refer to four different operations, or better, to four modifications of the same operation devised by four different operators, namely Kroenig, Hirst, DeLee, and Beck. Although they all have in common an incision in the cervix or the lower uterine segment, for the delivery of a child by the abdominal route, they differ somewhat in the disposition of the peritoneal layers after the closure of the uterine incision. DeLee has suggested the term laparotrachelotomy, and although the name is scientifically correct it has not been generally adopted; its use would result in the avoidance of a great deal of confusion. Some continental accoucheurs refer to the operation as the suprasymphyseal cæsarean section, while both American and European writers have referred to it as the low cervical cæsarean section.

EVOLUTION OF THE TRANSPERITONEAL CÆSAREAN SECTION

Since the early days of cæsarean section, the two main troublesome complications have been hæmorrhage and sepsis. Porro, of Pavia, in 1876, attempted to overcome these, and succeeded in doing so; but his method entailed the sacrificing of the uterus. In 1882 Saenger, by introducing a proper method of suturing the uterus, so improved the results of the classical operation that the Porro operation was relegated to its proper place, that is a method to be used for special indications in the presence of infection and neoplasms.

The method of uterine suture has passed through many stages, from the using of silver wire, silkworm gut, silk and linen to the present-day use of catgut; again, the uterus has been sutured in one layer, two layers, three layers, and four layers. Both interrupted and continuous sutures or a combination of them have been advocated. At the present time some writers are reviving the use of silkworm gut and linen as stay sutures in closing the uterine incision, thus tending to show that no method has been entirely satisfactory.

With the introduction of proper methods of suturing, the hæmorrhage from the cut edges of the uterine muscle has been largely controlled, so that, in present-day operating this condition is but rarely a troublesome factor.

The prevention of sepsis, however, has not shown such brilliant results and it is for this reason that numerous modifications of the classical operation have been devised for cases where infection was suspected but where one was reluctant to sacrifice the uterus.

The foremost authors in obstetrics are fairly well agreed that in the presence of a virulent infection the best results are obtained by the removal of the infected uterus; the present-day method differs from the Porro operation only inasmuch as the cervix is closed by sutures, covered with peritoneum and dropped back in the abdominal cavity, instead of being fixed to the lower angle of the incision. This means clean healing and a much shorter convalescence. It is further conceded that a virulent infecting organism, the streptococcus for instance, may find its way through the intact peritoneum and cause septic peritonitis even in a true extraperitoneal section.

A large group of cases with unrecognized disproportion between the pelvis and fetal head, come to us after many hours of labor, with ruptured membranes, and having had vaginal examinations in their homes. The disproportion may be such that a pelvic delivery is not feasible except by craniotomy on a living child. Although there may be no definite signs of infection, in the light of present-day knowledge, these cases are considered infected, or at least they are classified as presumably infected. In that type of case the classic operation is contra-indicated because of the danger of peritonitis.

[1] Read before the Obstetrical Society of Boston, April 24, 1923.

It is a well known fact that each hour of labor, each vaginal examination, and each hour that the membranes have been ruptured has a definite bearing on the morbidity and mortality of the classic cæsarean section. It is also well recognized that certain patients having fulfilled all the so-called textbook indications for this operation subsequently develop peritonitis. In the classical type of operation since the incision is made in the body, or contractile part of the uterus, the stitches, no matter how placed, must serve as hæmostatic as well as approximating sutures. For this reason they have to be tied rather tightly, and because of this a certain amount of pressure necrosis may result.

Since it has been possible to demonstrate the escape of lochia in the peritoneal cavity between the stitches, it is reasonable to presume that the bacteria which invade the puerperal uterus may find their way into the peritoneal cavity along the same channels, and since the peritoneal cavity is in no way protected from the uterine incision, peritonitis may be the result. This may explain the fact that peritonitis may sometimes develop in the so-called clean case.

The extraperitoneal methods have been largely developed in Europe, notably in Germany, and this because of the fact that so many of the patients coming to the Continental clinics are referred by midwives, the parturients being usually seen late in labor, after repeated vaginal examinations under poor aseptic conditions, and in such state that the classical operation is considered unsafe.

In 1907 Frank, of Cologne, described his operation for neglected cases. This consisted of a transverse abdominal incision, cutting across the recti; the peritoneum was separated from the bladder, and the anterior surface of the uterus, and enough of the lower segment was exposed for the delivery of the child. Later, this operation was modified by Latzko, Selheim, and others from the suprasymphyseal extraperitoneal operation into a suprasymphyseal transperitoneal section. The latter differed from the Hirst operation in that transverse instead of longitudinal incisions were made in the abdominal wall, the peritoneum, and the lower uterine segment.

Doederlein attempted to revive the operation of laparo-elytrotomy, which had been first suggested in 1823, and then taken up by Gaillard Thomas in 1871. Here the incision was made obliquely and parallel to Poupart's ligament. The incision offers easy approach to the pelvic connective tissue, and to the lateral portion of the lower uterine segment. After the incision of the lower uterine segment the child is delivered by forceps.

In 1915, Kuestner presented his method, which is a true extraperitoneal section, and reported 112 cases. Later, June, 1922, the same author reports 200 cases with two deaths.

In August, 1918, Markoe and McPherson published their article entitled "Extraperitoneal Cæsarean Section in Certain Infected Cases with the Carrel After Treatment." These authors advise the extraperitoneal operation in infected cases and describe their method, which is essentially that of Kuestner. Their results were excellent.

The above operations were true extraperitoneal sections, and probably offered the best means of protecting the peritoneal cavity. The disadvantages were that, not infrequently, the bladder and left ureter were injured with resulting fistulæ; second, the peritoneum was occasionally opened during its separation, thus losing the advantage of the extraperitoneal method; third, the pelvis had to be drained and this resulted in suppuration and long drainage in many instances; fourth, there was more hæmorrhage, since the incision in the lower segment had to be made to the side rather than in the median line, and the technical difficulties were greater; and last, the operation could not be repeated because of adhesions.

Kroenig brought a new light on the whole subject when he claimed that the better results obtained by this method were not due to the fact that the uterus was approached in an extraperitoneal manner but because the incision was made in the thin non-contractile lower segment rather than in the thick contractile body of the uterus. His operation consists of opening the abdominal cavity by a low longitudinal incision, separating the bladder from the uterus, making a longitud-

inal cervical incision, and after the extraction of the child, placenta and membranes, closing the uterine incision and completely covering it with the bladder by suturing the edge of the bladder peritoneum at a level higher than the upper aspect of the incision in the lower uterine segment.

In June, 1920, Barton Cooke Hirst described his technique in his *Atlas of Gynecology*, although he had previously brought his operation to the attention of the profession. He reported 30 operations on "almost certainly infected women" without a mortality. This operation is sometimes referred to as the Veit-Fromme-Hirst operation although in America it is known as the Hirst method.

DeLee, in June, 1919, presented his paper entitled "The Newer Methods of Cæsarean Section; Report of Forty Cases," before the section of obstetrics, gynecology, and abdominal surgery, at the seventieth annual session of the American Medical Association, at Atlantic City. This paper was subsequently published in the *Journal of the American Medical Association*. In this series of 40 cases performed by DeLee and his assistants there was no mortality. This author lays stress on the more comfortable convalescence and the absence of peritoneal shock and ileus. To quote him: "tympany and postoperative shock are decidedly less, and one gets the impression that a woman has suffered only a minor operation not the ordeal of the old cæsarean section." His technique is essentially his own modification of the Kroenig operation.

Cornell, in September, 1920, published his article, "The Cervical or Kroenig Cæsarean Section," in the *Illinois Medical Journal*. His observations confirmed those of DeLee.

In September, 1921, Beck described the "Two-Flap Low Incision Cæsarean Section" and reported 29 cases without mortality. He emphasized the fact that the operation was safe after an efficient test of labor.

In the same year (1921) E. Vogt, of Berlin, published his monograph "The Evolution and Development of the Suprasymphyseal Cæsarean Section." This is based on 183 operations performed at the Tuebingen Clinic, from 1908 to 1919. The author strongly advocates the cervical cæsarean section and believes that it has made the classical operation obsolete. He further believes that the intraperitoneal cervical cæsarean section is better than the extraperitoneal, because it is simpler technically, is free from injury to the neighboring structures, takes less time, and is less dangerous to the child when haste is imperative.

Polak and Beck, in May, 1922, illustrate the modified Kroenig cervical cæsarean section, in their article: "The Present Status of Obstetrics Referring to the Abuse of Cæsarean Section."

In June, 1922, Phaneuf and Hegarty described, in the *Boston Medical and Surgical Journal*, their methods of performing the Hirst and Kroenig cervical cæsarean sections, and reported their series of 40 cases. In this series 27 operations had been performed by Phaneuf and 13 by Hegarty. Of the 40 cases reported 33 were according to the Hirst and 7 according to the Kroenig technique.

Munro Kerr, in the *Journal of Obstetrics and Gynæcology of the British Empire*, 1922, xxviii, 475, compares the classical to the transperitoneal operation and states that the latter overcomes many of the difficulties of the former. He lays stress on the fact that there is less tendency to subsequent rupture if the incision is placed in the cervix, the noncontractile portion of the uterus.

In July, 1922, DeLee and Cornell in their paper "Low Cervical Cæsarean Section (Laparotrachelotomy)" report 145 cases with one death, and this in a woman very obese, with toxæmia, contracted pelvis, and days in labor. Death was from peritonitis on the fifth day. The authors state that this was a hopelessly neglected case that would have died no matter how delivered. DeLee in the *Practical Medicine Series* for 1922 reports 11 additional cases, or 156 cases with one death.

In the *Revue française de Gynécologie et d'Obstétrique*, Paris, xviii, No. 2, p. 33, January 25, 1923, P. Gaifami writes on the low transperitoneal cæsarean section and extols the advantages of section in the lower uterine seg-

ment. He describes 50 cases, several with beginning infection. The pregnant uterus was removed in one case 2 years later, and without the microscope no trace could be found of the incision. Conditions in the lower segment are more favorable for healing. In 11 cases the cæsarean section was repeated and the cicatrix was firm in all, even when the expectant treatment had been pushed to the extreme.

TECHNIQUE OF OPERATION (AUTHOR'S METHOD)

Hirst Operation

The abdomen is prepared and the patient is catheterized; she is then etherized and placed in a moderate Trendelenburg position. The operator stands on the left side as in the average pelvic operation; the incision which is median and about 5 inches long, starts at the symphysis and extends toward the umbilicus; the parietal peritoneum is opened in the median line, exposing the bladder and the lower uterine segment (intestines are practically never seen). The uterine peritoneum just above the bladder, where it is loosely attached, is incised to the uterine muscle; the index finger is introduced in the opening and the bladder is gently separated from the uterus; the finger is then directed upward and the peritoneum is separated from one side of the uterus. The procedure is repeated on the opposite side. The visceral peritoneum is then incised in the median line to within an inch of the upper limit of the incision in the parietal peritoneum, and the two layers of peritoneum-parietal and visceral-are united by carefully applied interrupted catgut sutures, about eight in number. We prefer the sutures to clamps as they are less likely to tear the peritoneum. The bladder is held under the symphysis by means of a retractor and a longitudinal incision is made in the cervix (an incision large enough to deliver an ordinary-sized child may be made entirely in the cervix, without encroaching on the corpus); the child is usually delivered by the vertex, using the obstetric forceps, if necessary, to assist in the delivery. Great care is used in making the incision in the thin cervix so as to avoid cutting the child's head. The placenta and membranes are extracted, a large strip of gauze is packed in the uterus, 1 cubic centimeter of pituitary extract is injected in the uterine muscle, and 1 cubic centimeter of aseptic ergot in the thigh. The cervical incision is closed with interrupted sutures of No. 2 chromic catgut, and the strip is removed before tying the sutures: the uterus is usually contracting well at this time. After sponging out the uterine incision, the peritoneal layers are further approximated by a continuous suture of No. 0 chromic catgut. As may be seen, the uterine incision is now entirely out of the general peritoneal cavity, and covered almost entirely by the bladder; the conjoined layers of peritoneum are united in the median line by two or three interrupted catgut sutures, and the abdominal wall is closed in layers.

The layers of peritoneum are adherent in the course of a few hours; uterine sepsis usually is apparent at the end of 24 to 48 hours, as shown by the rise of temperature and pulse, at this time, in infected cases. If infected lochia seeps through the uterine incision, it can be drained readily through the cervix, or through the lower end of the abdominal wound without coming in contact with the general peritoneal cavity.

Kroenig Operation

The patient is placed in the Trendelenburg position; the abdominal incision is made as in the Hirst operation; the visceral peritoneum is incised transversely where it is loosely attached just above the bladder, and the bladder is separated from the lower uterine segment; it is now held under the symphysis by a retractor and a longitudinal cervical incision is made within the denuded space; after the delivery of the child, the placenta and membranes are extracted, and the incision is closed with interrupted sutures of No. 2 chromic catgut; the bladder edge is drawn up so as to overlap slightly the upper edge of the transverse incision and then sutured to the uterus, with a continuous stitch of fine catgut, thus completely sealing off the uterine incision. The abdomen is closed in the usual manner.

The incision in the cervix is entirely covered by the bladder, and should infection occur,

drainage may be easily established through the cervix or by an anterior vaginal colpotomy.

Beck Operation

This differs from the Kroenig operation only in one respect, and that is in the fact that an upper flap of peritoneum is raised after separating the bladder. After the suture of the cervical incision is completed, the upper flap is brought down and anchored to the uterus by a few interrupted catgut sutures, thus covering over the upper part of the incision; the edge of the bladder peritoneum is then sutured, with a continuous stitch, in such a way that it overlaps the upper flap.

The claim made for this procedure is that it offers a stronger barrier to infection than does the original Kroenig operation. In doing the Beck operation we raise the peritoneum from the lower uterine segment in exactly the same way that we do in the Hirst operation, but we incise it transversely instead of longitudinally thus obtaining a superior and inferior flap instead of two lateral flaps.

In case of infection, drainage takes place through the cervix or the infected area may be reached by means of an anterior colpotomy.

DeLee's second contribution to the operation consists of uniting the fascia over the lower uterine segment by a continuous catgut suture, thus burying the cervical incision under this fascial layer. We have used this method in our last few cases.

PROTECTION AGAINST INFECTION OF THE PERITONEAL CAVITY

There are two points of view on this question: first a number of obstetric surgeons believe that in order to protect the peritoneal cavity, in a presumably infected case, the extraperitoneal route must be strictly adhered to; while others feel that in the presumably infected woman the transperitoneal route offers definite protection. To quote Hirst on the transperitoneal operation: "This method is comparatively simple; and the result has proved (in my experience) that it is reliable, preventing infection of the peritoneal cavity, especially during puerperal convalescence, which is the chief danger of cæsarean section upon the presumably infected woman, the infection of the endometrium in such cases spreading directly through the uterine wound to the peritoneal surface and rapidly causing a general septic peritonitis." Newell states that when a woman is frankly infected, no operation which conserves the uterus offers a good chance of preventing peritonitis since even in the extraperitoneal section the bacteria may find their way through the unopened peritoneum. For this reason he advises the removal of the uterus in that type of case. We have not done the transperitoneal operation on a frankly infected case; but in our hands this procedure has given definite protection in the presumably infected woman. Many obstetricians feel that the danger of infection does not come so much from the spilling of the uterine contents at the time of operation as from the passage of lochia and bacteria between the sutures after delivery.

At the present time we resort to the Hirst operation in our doubtful cases, and to the Kroenig or Beck operation in our clean cases.

THE CERVICAL INCISION

The cervical incision has a number of points in its favor. The cervix is that part of the uterus which stands infection the best—a fact repeatedly observed in gynecological practice. The pelvis is also more resistant than the upper abdomen; the wound is placed in the non-contactile part of the uterus and may heal undisturbed. The healing of the cervix is better than that of the fundus because active involution and the fatty degeneration of the uterine wall defeat the healing powers of the tissues (Munro Kerr).

This incision is well covered with peritoneum which is adherent in the course of a few hours, so that when bacteria invade the uterus, as they usually do on about the fifth or sixth day, if the uterine incision breaks down a local abscess forms which drains itself through the vagina, or through the lower angle of the abdominal incision, or it may be readily reached through an anterior vaginal colpotomy.

TABLE I.—TOTAL NUMBER OF OPERATIONS

	Hirst	Kroenig	Beck	Total
Cases operated upon by the author	30	23	5	67
Cases operated upon by Dr. J. G. Hegarty	10	3	..	13
Total	49	26	5	80

TABLE II.—NUMBER OE PREGNANCIES

	Hirst	Kroenig	Beck
Para-I	34	11	2
Para-II	8	8	1
Para-III	..	3	..
Para-IV	3	2	..
Para-V	1	1	..
Para-VI	1	..	..
Para-VII	1	1	..
Para-VIII	..	..	..
Para-IX	..	..	..
Para-X	1	..	..
Total	49	26	5
Total cases			80

TABLE III.—LABOR

	Hirst	Kroenig	Beck
Test of labor	33	10	2
No labor	16	16	3
Total	49	26	5
Total cases			80

Of the 33 Hirst operations who had labor, one had 36 hours, one 24 hours, and one 20 hours. The others had labor varying from 4 to 15 hours.

RUPTURE OF THE SCAR IN SUBSEQUENT PREGNANCIES

The incision in the lower uterine segment reduces to a great extent the possibility of rupture of the scar in subsequent pregnancies, because of the fact that the incision heals at rest and undisturbed. In our series there were six secondary operations, one in a woman who had had a septic uterine incision and a utero-abdominal fistula. In none of these cases were there any weak points in the scar and it was almost impossible to distinguish a scar as such. In his 12 cases which came to secondary operation Gaifami found no signs of weakening in any of the scars.

ADHESIONS

Following the Hirst operation, one finds a band of peritoneum extending from the abdominal wall to the cervix. Four of our cases came to secondary operation. We merely divided the peritoneal band between ligatures, separated the bladder and performed the Kroenig section. In the two Kroenig hysterotomies who came to operation the second time, no adhesions were found and there was not the least difficulty in separating the bladder for the second time. As the latter operation is completed, but a short line of suture is exposed, and that is where the peritoneum is attached to the uterine wall; this sinks in the pelvis and is entirely covered over by the bladder as this organ fills.

TEST OF LABOR

The patient may be given an efficient test of labor and this with safety. The result of this is that a number of cases are delivered through the pelvis who might have been delivered abdominally with the absence of this test. It is a well-conceded fact that an efficient test of labor adds materially to the morbidity and mortality of the classic operation. DeLee, Cornell, Routh, Holland, and Beck, all agree that an efficient test of labor is safe with the cervical section. Our own experience bears them out. In German clinics the low cervical operation is performed even if the parturient has fever (DeLee).

HERNIA IN THE ABDOMINAL INCISION

Hernia has not been encountered in our cases, even the women who developed utero-abdominal fistulæ obtained firm scars. It is a known fact that herniæ in suprapubic incisions are less common than in the other parts of the abdomen.

CONVALESCENCE

The convalescence in cases of the cervical section is practically that of a pelvic delivery. The puerperium is so comfortable following the low cervical operation that one cannot help but be impressed with this advantage. A rare case develops a moderate distention, but we have been impressed with the fact that, in our series, it has always been a soft distention, causing the puerpera no discomfort. The patients are free from ileus, the temperature and pulse remain near the normal line, and no signs of peritoneal shock are observed. If the operation accomplished

TABLE IV.—PELVIC EXAMINATIONS

	Hirst	Kroenig	Beck
Vaginal examinations	0	1	0
Rectal examinations	40	25	5
Total	40	26	5
Total cases			80

The largest number of vaginal examinations on one case was six.

TABLE V.—INDICATIONS

	Hirst	Kroenig	Beck
Cephalopelvic disproportion	30	11	1
Abruptio placentæ	3	..	..
Complete placenta prævia	6	1	..
Eclampsia; rigid primiparous cervix	2	3	..
Previous classical cæsarean section	4	3	1
High breech; contracted pelvis	3	1	..
Transverse; right scapuloposterior. Para. V. Four Stillborns	1	..	..
Previous Hirst operation	..	3	1
Large dermoid cyst obstructing labor	..	1	..
Soft part dystocia from previous plastic	..	..	..
Operations and suspensions	..	3	..
Diabetes. Toxæmia of pregnancy	..	..	1
Elderly primipara (40). Rigid cervix	..	..	1
Total	49	26	5
Total cases			80

nothing more than the comfortable convalescence, it would be worth while doing for this reason alone.

MORBIDITY

Hirst Operation—49 Cases

Seven puerpera had septic uteri and uteroabdominal fistulæ, discharging pus freely through the vagina and through the abdominal incision. All wounds were irrigated with Dakin's solution. All the patients recovered. None of the cases developed peritonitis. This group tends to prove that the union of the peritoneal layers in the Hirst operation offers a definite protection against peritonitis.

Case 1. Para-I. Abruptio placentæ, packed twice, once in her home, attempts at manual dilatation before admission.

Case 2. Para-I. Admitted after 36 hours of labor with a floating head and ruptured membranes. This case was one of extreme sepsis, the whole cervical incision broke down, and one could introduce the sterile fingers through the abdominal opening into the fundus as well as into the cervix. She ran a temperature ranging from 105 to 102, with a pulse of 150 to 130 for 20 days. On the twentieth day her hæmoglobin was 30 per cent and she was transfused on this day. She left the hospital on the fifty-second day with a healed incision and in good health. The impressive fact about this case was that while pus was pouring freely from the broken down cervical incision, there was not the least sign of peritoneal irritation, the bowels and bladder functioned normally, and she experienced no abdominal symptoms.

Case 3. Para-I. Right occipitoposterior, floating head, long labor, vaginal examinations outside.

Case 4. Para-I. Right occipitoposterior, floating head, few hours of labor, no engagement, intact membranes, no vaginal examinations. This might have been considered an ideal case for the classic operation.

Case 5. Para-I. Short test of labor, breech left sacroposterior neurotic woman, no progress, intact membranes, no vaginal examinations. This case might also have been considered in an ideal condition for the classic operation.

Case 6. Para-I. Elderly, in labor a number of hours before admission, no engagement, intact membranes, eczema of the vulva, no vaginal examinations.

Case 7. Para-I. Admitted fully dilated, no engagement, membranes intact, no vaginal examinations.

These seven cases with septic, broken-down cervical incisions were prevented from having general septic peritonitis by the protection offered by the united peritoneal layers. They all recovered and were discharged with healed incisions. One of them, the first case, who was operated upon later by the Kroenig method showed a perfectly healed cervix. Another, Case 4, now 5 months pregnant, is in the writer's care, and her second pregnancy is progressing satisfactorily. Two of the cases fulfilled the indications for the classical operation, that is, just enough labor to dilate their cervices for drainage, intact membranes, never examined vaginally during pregnancy or labor, and yet, we are convinced that they would have died of peritonitis had the latter operation been performed. The last two cases may explain the occasional case of peritonitis, following the classic operation, when we feel that all indications have been fulfilled. Furthermore, it tends to prove that the infecting bacteria were present in their vaginæ, since they were never carried in by the examining fingers. The other five cases were considered potentially infected.

Six patients had mild uterine sepsis, with a temperature of 101 degrees, they had no abdominal complications and they all did well.

One patient had bilateral mammary abscesses, a second had bronchopneumonia, while a third had pyelitis.

Kroenig Operation—26 Cases

One patient had pulmonary embolism during the operation, which was followed by pneumonia and recovery: another had a pulmonary embolus the twelfth day after operation: she also recovered. Two puerperæ had thrombophlebitis of the left leg; they left the hospital well. One mother had acute dilatation of the stomach; she recovered.

Beck Operation—5 Cases

There were no complications.

MORTALITY

Hirst Operation

CASE 1. Para-VII, spondylolisthetic pelvis, six stillborn children following forceps extractions, admitted after considerable labor in her home, no vaginal examinations. She died of pulmonary embolism on the fifth day after delivery. There were no abdominal complications.

CASE 2. Para-I, 41 years old, in labor 16 hours. One vaginal examination in her home. Died of acute gastric dilatation on the fourth day. The parturient who was about 5 feet in height weighed 250 pounds, she had a sharp promontory, and no engagement after 16 hours of labor. She had had acute dilatation of the stomach following an appendectomy a few years previously and her history showed that she had nearly died of this complication.

CASE 3. Para-I. Abruptio placentæ at term with a severe uterine hæmorrhage. She had no dilatation and no labor. She died of the results of hæmorrhage the day of operation.

Kroenig Operation

CASE 1. Para-II, 28, first labor breech presentation, stillborn, poor physical condition, attack of appendicitis when 7½ months pregnant, and she ran a pulse of 120 during pregnancy. Extensive plastic operations following the first delivery. Test of labor, no dilatation of the cervix, operation August 23, 1922. She developed an abscess between the bladder and cervix, which was drained by an anterior vaginal colpotomy on September 3, 1922. She subsequently developed a bronchopneumonia and died. At the time of her death the abdominal incision was healed, and she had had no abdominal symptoms.

CASE 2. Para-I, 42 years old, at term, eclampsia, frequent convulsions, no labor, no dilatation, moribund when seen. Operation in the interest of the child. The mother died shortly after operation and the child lived.

CASE 3. Para-I, 36 years old, at term, eclampsia, frequent convulsions, in deep coma, cyanosed and jaundiced, no labor, two vaginal examinations, 1 ounce of black urine obtained on catheterization, delivered of a macerated fetus. No urine was obtained after operation and she died 14 hours after delivery.

Beck Operation

There was no mortality following this operation.

Total mortality 6 cases in 80, or 7.5 per cent. The mortality in this series cannot be entirely attributed to the operation. One mother died of pulmonary embolism on the fifth day, and while this is a complication of cæsarean section, it also occurs as frequently after pelvic deliveries. The two cases of eclampsia, in the writer's opinion, died because of lack of prenatal care; they were both elderly primiparæ and when seen in consultation it was too late to hope to save them. The parturient with the premature detachment of the placenta had to be delivered at once because of the hæmorrhage, she was at term, she had a long rigid cervix, and no labor. After the delivery of the fetus, the extraction of the placenta and membranes, and the removal of a large quantity of blood clot, the patient went into severe shock. She rallied after the intravenous injection of 1000 cubic centimeters of salt solution, but a few hours later began to fail, and died just as the writer was reaching the hospital to transfuse her. This leaves two patients (2.5 per cent), one who died of bronchopneumonia, after having had an abscess drained and, as stated before, without having had any abdominal complications. The pneumonia may have been secondary to the abscess or it may have been the result of the patient's markedly weakened condition. Acute gastric dilatation is not usually seen after pelvic deliveries, so in this case the operation may be said to have been the cause of death, and yet, one of the patients in the series of Kroenig operations recovered from this same complication.

TABLE VI.—ANÆSTHESIA

	Hirst	Kroenig	Beck
Ether anæsthesia	49	24	5
Spinal anæsthesia	..	2	..
Total	49	26	5
Total cases			80

Spinal anæsthesia was administered to two women who had severe upper respiratory tract infections. The operation is well adapted to spinal anæsthesia, the only variation in technique being that the patient is not placed in the Trendelenburg position. The extensive dissection of the peritoneum would make the operation difficult to do under local anæsthesia.

SECONDARY OPERATIONS

Four gravidæ had Kroenig operations after having had the Hirst operation; one had a Beck operation after the Hirst operation; while another had two Kroenig operations; thus making a total of six secondary operations. In none of these were we able to identify a scar, as such, in the cervix, and there was no difficulty in separating the bladder a second time. It is interesting to note that the first case who came to a secondary operation was the first done in the Hirst series—this was a septic case with a utero-abdominal fistula—and yet, at the second operation the incision was found perfectly healed and no weak points were discovered. As far as the cicatrix was concerned the parturient might have had a pelvic delivery with safety had it not been for the fact that she had an absolute indication.

TABLE VII.—FETAL MORTALITY

Five children died, four after the Hirst operation and one after the Kroenig operation, or a mortality of 6.25 per cent. The causes of death were the following:

Macerated fetus	2
Stillborn	1
Atalectasis	2
Total	5

CONCLUSIONS

1. The transperitoneal cæsarean section offers protection against septic peritonitis;
2. There is practically no shock as the intestines are not handled;
3. There is less bleeding;
4. The mother has a much easier puerperium;
5. There is better healing since the incision is in the cervix, the non-contractile part of the uterus;
6. There is less danger of rupture in subsequent pregnancies and labor;
7. An efficient test of labor may be given with safety;
8. We prefer the Hirst operation in doubtful cases, and the Kroenig or Beck operations in clean cases.

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THE TREATMENT OF CARDIOPATHS IN PREGNANCY AND LABOR[1]

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THE prognosis of pregnancy in women in whom cardiac lesions exist is often very difficult. The experienced observer may often be in doubt as to the degree of danger to be feared and as to the proper course to pursue. Women whose hearts are seriously compromised, even in whom decompensation is found, will sometimes pass through pregnancy and labor, particularly if judiciously managed, with comparative ease. Others, whose hearts apparently give but little reason for anxiety, indeed sometimes when careful examination discloses no abnormality, may be overtaken by serious trouble and at times by disaster. The problem of estimating the degree of risk, and of determining the safest course to pursue often perplexes us.

We have had a number of cardiopaths to deal with on the gynecologic-obstetric service of the Evanston Hospital in recent years. Of these, the most striking example of the class of cases alluded to above, in which examination discloses no deviation from normal, yet disaster follows, is here reported.

Case 1. Primipara, age 28. Physical examination during pregnancy had shown no physical abnormality and repeated observation of blood pressure and examination of the urine during pregnancy showed nothing noteworthy. Labor came on at term. The child lay in left occipito-anterior, there was no disproportion, and labor proceeded in an entirely normal manner. After 5 hours, the os was dilated three fingers' breadth, and at this time the heart was auscultated and found normal, and the pulse was not above the normal rate. After 8 hours of apparently normal labor the head was on the perineum, the parturient seemingly in excellent condition. After a delay of 45 minutes on the perineum, it was decided to complete the delivery by forceps. The woman was placed in position and anæsthesia begun, using Squibbs' ether on an open mask. After 4 or 5, minutes the interne began to sponge off the external urethral meatus, preparatory to catheterization. She moved her limbs vigorously at which he ceased, to await completion of anæsthesia. Not more than 1 minute later the anæsthetist reported that the woman was not breathing. At first this caused no alarm, attempts being made to cause her to breathe by pulling the jaw forward. After a moment it became apparent that the condition was alarming, and attempts were made by every means with which we were acquainted to cause her to breathe, but without avail. No further respiration occurred and in about 7 or 8 minutes the heart ceased. Prior to the stopping of the heart the child was rapidly extracted with forceps. It, however, succumbed a few hours later.

An autopsy was made by the coroner's physician, who fortunately was an experienced pathologist. The entire reproductive tract was found wholly normal, no injury to the uterus being present and the placenta being firmly attached to the uterine wall. No emboli could be found in the vessels of the lungs and none was present in the heart. There was a chronic adhesive pericarditis, the pericardium being firmly attached to the heart over its entire surface. The heart muscle seemed paler than normal and a provisional opinion of death from myocarditis was given. Microscopic examination of the heart muscle made later did not show evidence of degeneration.

This death must, it would seem, be ascribed to anæsthesia, the disastrous effect of the anæsthesia, perhaps, being the more easily produced by reason of the handicapping of the heart muscle by the old pericarditis. We cannot too strongly urge the importance of the pericarditis in determining the cause of the death, as the heart continued to beat for some minutes after respiration had stopped.

It is probable that this death must be ascribed to anæsthesia, inasmuch as autopsy failed to disclose a sufficient explanation.

There can be no death more distressing than that of a young and apparently healthy woman in labor. Happily the physician is not frequently called upon to experience the sense of helplessness and defeat which are his when witnessing such a catastrophe. But that such deaths are by no means unknown is demonstrated by an examination of the literature. In 1905 Davis reported a case of death during the termination of pregnancy and collected twenty-five other published cases.

An examination of the literature since the publication of Davis' paper discloses 54 cases of death during the termination of pregnancy or immediately thereafter. We have excluded

[1] Read before the Chicago Gynecological Society, April 20, 1923. (For discussion see p. 852.)

all deaths from this list from obstetric accidents such as hæmorrhage, rupture of the uterus and eclampsia, and have included only those due to circulatory causes. Of these we have included only those in which death occurred during the process of parturition or immediately thereafter, excluding those in which many hours had elapsed before death. The following table shows the reported causes of death.

Cardiac lesions		29
Mitral stenosis	15	
Myocarditis	7	
Bicuspid lesions	4	
Pericarditis	1	
Endocarditis	2	
		29
Embolism		8
Air embolism		2
Cerebral hæmorrhage		2
Pulmonary tuberculosis		1
Cause in doubt		12
		54

In endeavoring to arrive at an estimate of risk in a given case it is evident that the type of cardiac lesion must be considered. Mitral stenosis has claimed more victims than any other cardiac lesion in the cases as reported. Myocarditis occupies second place. Our own experience is in accord with this. It is of interest that lesions of the mitral valve do not appear in the list at all, unless one or both of the two cases indefinitely reported as "endocarditis" be of this type.

It would seem that aortic regurgitation should be even more serious in its consequence than mitral stenosis. Pardee finds in his experience that it is about twice as likely to cause trouble. They occur only half as frequently as mitral stenosis, which he feels is the reason for the latter lesion being more greatly feared. We have perhaps been fortunate so far in not encountering one.

The heart of the pregnant woman demands careful study, which should be begun as early as possible in the pregnancy. A carefully taken history is essential, eliciting such facts as the occurrence of rheumatic fever, repeated tonsillitis, chorea, scarlet fever, diphtheria, or other infections likely to leave cardiac damage behind them. Careful routine physical examination of the heart should be made, including observation of blood pressure, systolic and diastolic, in order that the pulse pressure may be known. The presence of a murmur is by no means always an occasion for alarm, nor does its absence invariably confer a sense of complete safety. The most important question is whether the heart is fulfilling its function without effort. In our own work we are accustomed to pay particular attention to previous history of endocarditis. The presence of demonstrable cardiac enlargement, and any sign of decompensation, such as dyspnœa on effort, slight œdema of the ankles, especially when crepitant sounds are found at the bases of the lungs, is regarded as evidence of possible danger. A pulse pressure of less than 30 indicates a heart muscle of diminished efficiency, and a systolic pressure persistently 100 or less is a cause for anxiety. Evident decompensation in early pregnancy is a valid reason for emptying the uterus. In cases giving definite evidence of impairment of cardiac efficiency, we should have the co-operation of the internist.

We are most concerned when we are dealing with mitral stenosis and myocardial degeneration. These are, according to the table given and also according to our own experience, the most dangerous lesions. The difficulty as to prognosis in these cases may be illustrated by the following cases.

Case 2. II-para, age 26, seen in consultation during her first pregnancy on account of paroxysmal tachycardia. She went through this pregnancy and was safely delivered in another city. In her second pregnancy she was under the writer's care. She had a mitral stenosis and regurgitation, a presystolic murmur being easily heard. She had a number of attacks of paroxysmal tachycardia. She was seen by an internist, and the question of the advisability of terminating pregnancy was considered. It was decided not to do this and the pregnancy proceeded under careful observation. She went through labor without the slightest difficulty. As the second stage was evidently going to be rapid and she was in excellent condition she was allowed to deliver herself.

Case 3. I-para, age 22. Apparently in vigorous health. Had recently completed her training as a nurse in a large hospital. While thus actively employed she had had no evidence of any trouble with her heart. Three years before she had had a severe attack of epidemic influenza. During her entire pregnancy her heart gave no sign of any abnormality. Immediately on the onset of labor she had an acute dilatation of the heart, a rapid irregular pulse with beats of varying strength, some not palpable at the

wrist, dyspnœa, and cyanosis. She was at once given large doses of morphine to delay the labor, and following the advice of a medical consultant heavy doses of digifolin intramuscularly. Pains ceased for nearly 24 hours, then recommenced. By this time the pulse was again regular and the dyspnœa greatly lessened. She was allowed to proceed with administration of morphine until dilatation was complete. As the child was right occipitoposterior, a manual rotation was done, followed by forceps extraction. She stood the entire labor and operative procedure well.

In the one case the fears occasioned by the presence of physical signs and evidence of functional impairment were not realized. In the other evidently a myocardial change was present which was not shown by careful examination in pregnancy but which became apparent immediately upon the imposition of the extra strain of labor.

Sir James Mackenzie divides heart force into two forms: rest force, which is sufficient for the needs of the body when at rest, and reserve force, which is used only when an effort is made. The reserve force is drawn upon in pregnancy. The maintenance of the fetal circulation, the carrying of extra weight by the mother, and the embarrassment of the heart itself which follows the alteration in movement and shape of the chest, all make demands upon it. And labor makes a still greater demand, a demand which may entirely obliterate the narrow margin of reserve remaining after the demands of pregnancy have been met.

If we could accurately measure the reserve force we should be far better able than we are at present to estimate the danger in a given case.

The woman with a heart which in early pregnancy is definitely decompensated need not perplex us. The course to pursue in such a case is perfectly obvious. Should the case be one in which one cannot expect the ultimate recovery of the heart to a point at which pregnancy and labor may be regarded as safe, the advisability of emptying the uterus from above by hysterotomy and sterilization by excision of the cornual ends of the tubes may be considered. Should a general anæsthetic be considered dangerous it may be done under local anæsthesia and morphine-scopolamine. A combination of these and a properly given gas anæsthesia or analgesia works very well. In a limited experience we have found this combination to be a useful method in severely compromised cases.

In those cases in which immediate termination of pregnancy is not indicated, and these cases are by far the more numerous, one faces the task of constant careful observation during pregnancy and the choice of the safest means of accomplishing delivery at term.

In the rather frequent cases of regurgitant mitral lesions which are well compensated, as evidenced primarily by the fact that the circulatory function is well maintained, and only secondarily by consideration of the murmur which may be present, we ordinarily feel but little anxiety, as experience has shown that these cases nearly always pass through pregnancy and labor well, frequently sustaining the strain of a protracted labor without incident.

Mitral stenosis is a more serious matter. Where this lesion is present careful attention must be paid to the heart throughout pregnancy, the woman cautioned regarding strain. Those of us who are caring for patients in large cities must be careful in regard to that numerous class of patients who live on the second or third floors of apartment buildings which contain no elevators.

Complete bed rest and administration of heart stimulants should begin on the slightest evidence of lack of compensation, preferably with the collaboration of an internist. The appearance of auricular fibrillation necessitates complete rest and reduction of pulse rate by digitalis. Should any evidence of pulmonary œdema or hepatic enlargement appear, termination of pregnancy must be considered.

The termination of pregnancy requires decision as to the best way of emptying the uterus. Our experience has led us to prefer, with a very occasional exception, delivery by the normal route. It has seemed to me that those who make frequent use of abdominal section in cases complicated by heart lesions are attracted by the fact that delivery may be rapidly accomplished, but fail to appreciate the fact that a woman who has had an abdominal section has still a postoperative period to pass through, which, in the case of

cæsarean section, is not always as free from strain as we might wish. Our observation in a considerable number of sections has been that distention and vomiting occur, even in cases in apparently excellent condition prior to operation, and despite the fact that the operation may have consumed but a very brief time, to a considerably greater degree than in gynecological laparotomies which may be much more difficult and time consuming. This throws a considerable measure of strain upon a compromised heart and may easily prove to be too great a load for the heart which has passed through the operation well. We prefer as a rule, therefore, to allow our patients to pass through the first stage, lessening their discomfort by the use of morphine, with which we are inclined to be rather liberal, giving often considerably more than we would give in a similar case with no heart to consider.

In multiparæ at the end of the first stage, the second stage, including delivery, is allowed to proceed normally with the addition of gas analgesia, provided the second stage is evidently going to be short and accompanied by little strain, and provided the patient's heart has shown no sign of failing.

In primiparæ, and in those multiparæ in whom we fear the strain of the expulsive stage, the labor is operatively terminated at this point, with a minimum of trauma. Morphine is often again given at once after labor to promote rest and to quiet the heart.

This conservative course has, we believe, yielded us as good results as we could hope to attain. Fortunately the cardiopath tends to have a rather easy first stage, and, particularly in multiparæ, the entire labor is often far less taxing than the anxious attendant had dared hope.

Difference of opinion, of course, exists as to the best and safest way to end the pregnancy. Induction of labor and cæsarean section both are suggested and recommended by various writers. The labor which comes on spontaneously has in our experience been a more rapid and more satisfactory one than the induced labor, and this fact has caused us to reject induction as a rule. The fact that labor not infrequently ceases after expulsion of the bag is a disadvantage as the woman and her compromised heart are subjected to a strain which is unproductive, and must be undergone again.

In our experience, too, it has seemed quite clear that after cæsarean section the strain of vomiting and that which is incident to abdominal distention and measures directed toward its relief, when added to that due to the operation, make up a sum total greater than that which many of our patients have had in accomplishing delivery by the natural passages. The latter has the great advantage of permitting the woman to have complete rest immediately after labor. We would, therefore, reserve section for cases which seem to promise unusual difficulty in labor.

We have not discussed the use of the electrocardiograph. In our own work it has not been used, and we have therefore no basis of personal experience. The gynecologist or obstetrician is not competent to evaluate this modern refinement of diagnosis. It would seem, however, that at least in the great majority of cases of cardiac lesions in pregnancy a sufficiently comprehensive idea may be attained by careful examination and observation, particularly if the collaboration of the internist be sought.

The great majority of men who are forced to accept the responsiblity of management in cases such as those we are discussing are without access to such apparatus. Trained faculties and painstaking observation, in the opinion of internists of wide experience, seem still to be the most valuable means of determining diagnosis and treatment.

The necessity for a cultivated operative dexterity and the employment of a minimum amount of trauma is so obvious as to require no emphasis.

The question of anæsthesia is one of primary importance. The importance of the anæsthetist as a member of the surgical team has received increasing recognition of late years. A woman with a decompensated heart, who needs operative intervention, may well tax the skill of the most experienced anæsthetist. The operator who must work in an institution in which anybody gives the anæsthetic will, in spite of his best efforts, have an occasional bad result in these cases which might possibly have been avoided with better anæsthesia.

While we have for some time used nitrous oxide for nearly all obstetric surgery except version or manual rotation of the head, both of which require a little more relaxation than is easily obtainable with gas, we believe that carefully given drop ether is preferable for operative work in cardiac cases except when fully compensated. The ether has some value as a heart stimulant, and causes less rise of blood pressure. I wish in this connection to record my appreciation of the complete and whole-hearted co-operation which I have received from the anæsthetists of the Evanston Hospital in meeting many difficult situations.

For ideal results one must have the assistance of anæsthetists of proper general training together with some especial experience in obstetric anæsthesia.

SUMMARY

1. The functional capacity of the pregnant woman's heart should be considered as early in pregnancy as possible. The aid of the internist in this and other things is of the greatest value.

2. Immediate attention must be given to any evidence of overstrain of the heart.

3. Of the lesions commonly seen, mitral stenosis and myocarditis are by far the most to be dreaded.

4. Delivery by the natural passages is ordinarily preferable, aided by morphine in the first stage and operative delivery if needed in the second stage.

5. Cæsarean section is, as a rule, not the best treatment for women with decompensated hearts.

SACRAL TERATOMA

By GEORGE DAVID CUTLER, M.D., F.A.C.S., Boston
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THE following report of a case of congenital sacral teratoma with operation 15 hours after birth is considered sufficiently interesting and unusual to warrant reporting.

J. M. (C. H. No. 50261), an Italian infant 15 hours old, was referred to the Children's Hospital by Dr. D. J. Herlihy of Cambridge, Massachusetts, June 24, 1922, for examination and treatment of an unusual tumor over the sacrum. The family history was negative. Physical examination showed a well-developed and nourished infant with entirely negative physical examination except for local condition. Local examination over the sacrum and upper part of the gluteal region showed a fairly solid, irregular, rounded tumor, 3 by 4 inches in size, with soft cystic tissues protruding from an opening in a tube of skin covered with hair. The pre-operative diagnosis was sacral teratoma.

Operation. Ether. Excision of teratoma. Two curved incisions were made around the base of the tumor over the sacrum, with the long axis in the transverse direction, the skin flaps were dissected away from the mass, which was found to contain a good sized piece of bone which seemed to articulate with the sacrum. The mass was dissected free with scissors. During the dissection a small sized cyst containing gelatinous material was opened. The sacrum felt normal in size and shape and position. Two good sized vessels of supply entered the mass on either side. These were clamped, cut, and tied with chromic catgut. The wound was closed with buried stitches of plain catgut to the subcutaneous fascia and interrupted stitches of silk to approximate the skin edges, making a satisfactory reconstruction of the buttocks. The patient made an uneventful recovery from operation and has been followed up for over 6 months. Development has been normal.

I am indebted to Dr. S. B. Wolbach for the following pathological report:

"The tumor contains a number of different tissues grouped together without order or sequence. There is bone in juxtaposition to nervous tissue, and nerve tissue in contact with epithelium-lined spaces equipped with glands, suggesting the mucosa and adnexa of bronchi. There are also islands of cartilage fat, and acini resembling the acini of the breast. In connection with the nerve tissue there are plexuses of vessels with and without a covering of epithelium resembling choroid plexus. Where the bone is cancellous there is marrow in which there are blood forming cells. There are large masses composed apparently of ganglion cells and nerve fibrils. There are normal arteries and veins of large size. Medullated nerve fibers are present. In blocks examined the different tissues suggest an organoid development; no cells were found having the arrangement usually seen in tumors."

I have been unable to find a similar case among the records at the Children's Hospital, Boston. The condition is described in Keen's *Surgery* (1) where the following definition appears: "A teratoma is an irregular conglomerate mass containing the tissues and fragments of viscera belonging to a suppressed fetus attached to an otherwise normal individual." Two forms are named: external and internal. The case herewith reported represents the external type of teratoma.

Without going further into a consideration of teratology, when two embryos are conjoined and one goes on to complete development while only certain parts of its companion continue to grow, the result is a parasitic

Fig. 1. Posterior view of infant and teratoma. Note the tube of skin covered with hair with mass of tissues protruding through an aperture.

Fig. 2. Left lateral view showing relation of parasite to autosite.

Fig. 3.

Fig. 4.

Fig. 5.

Fig. 3. Relation of the mass to the anus. Note the protruding mass of soft tissues definitely to the right of the median line. Discoloration of perineum, vulva, and buttocks due to meconium and a little blood.

Fig. 4. Five days after operation.

Fig. 5. Showing operative wound. Lateral view, 5 days after operation.

Fig. 6. Roentgenogram taken after operation to demonstrate condition of the sacrum.

Fig. 7. Roentgenogram of specimen taken to show the configuration of the bony structures.

fetus. The mature individual supporting it is called the autosite. The case reported above is one in which the suppressed fetus is represented by the mass growing from the posterior surface of the sacrum. For a more complete description of the condition, the reader is referred to textbooks on pathology (2) and embryology (3).

In the recent literature, Bolognesi (4) has written on cystic teratomata, stating that the site of predilection is the sacrococcygeal region. He reports a case in a twenty day old infant from whom the tumor was removed with satisfactory result. He comments on the fact that these tumors are monstrosities rather than neoplasms. Montgomery (5) published an article last year on this subject

and reported a case of sacral teratoma containing a scapula. He gives the differential diagnosis of tumors in the sacral region naming ordinary lipomata, lymphangiomata and congenital sacrococcygeal tumors, which have been classified by Ewing into dermoids, simple or complex; teratoid tumors; teratomata; and fetal implantations. He considers the roentgen-ray examination of considerable assistance in the diagnosis of these teratomata, and remarks that because of the operative dangers, a neurological examination should be made to differentiate a teratoma from a meningocele, especially when the latter accompanies and forms a part of a teratomatous growth.

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ENTEROCYST

With Report of a Case

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The Clinic

THE patient was a male infant, delivered by breech presentation after a normal gestation. He was the ninth child, all brothers and sisters living and well and without apparent congenital abnormalities. His weight at birth was 7¾ pounds.

During delivery and until time of operation a considerable quantity of meconium was passed; nothing else. The baby was delivered at 10 a.m. and was put to the breast during the afternoon and night and was given water several times. On the morning of the second day, vomiting began, at first of undigested fluids, and later of meconium. Gastric lavage was used without relief. Distention was first noticed the morning of the third day and was not relieved by enemata or stupes applied to the abdomen.

Visible peristalsis was at no time seen nor was a mass palpable. Shifting dullness was not elicited. Urine was voided normally and catheterization of the bladder showed no retention. The pulse and temperature remained practically normal. The child at no time seemed to be in pain.

On the morning of the fourth day operation was decided upon as the symptoms had become more pronounced. A diagnosis of intestinal obstruction, with intussusception or a congenital abnormality for cause, was made.

A right rectus incision was made below the umbilicus. Considerable cloudy fluid escaped on opening the peritoneum. All of the small intestines were greatly distended and deeply injected. Exploration in the cæcal region revealed a round, cystic tumor, about 1.5 centimeters by 1 centimeter, protruding from the anterior surface of the ileum, about 6 centimeters proximal to the ileocæcal junction. The gut distal to the cyst was collapsed and distended above. This cyst was quickly shelled out. It was then noticed that what was at first thought to be the lower portion of the distended gut was another cyst of about the same diameter as that of the distended gut above. The entire cyst-bearing area was then resected and an end-to-end anastomosis performed. Intestinal contents passed through the anastamosis after its completion. No other abnormalities were noted at operation, either in the intestine or the parietal peritoneum. The patient left the table in fair condition, but died about 5 hours later. No autopsy was secured. The pathological report on specimens removed at operation follows.

The tissue submitted for examination was a short segment of small intestine (ileum) some 5 centi-

Fig. 1. Drawing from photograph of enteric cyst, with enveloping section of ileum.

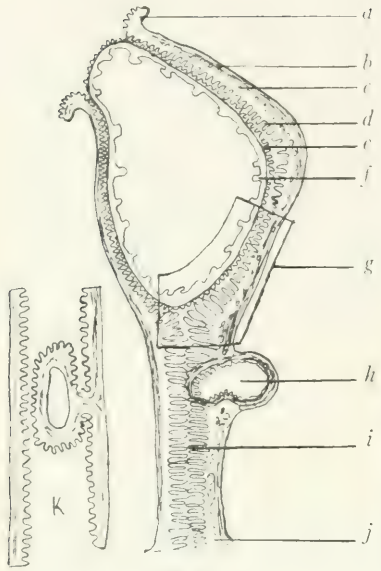
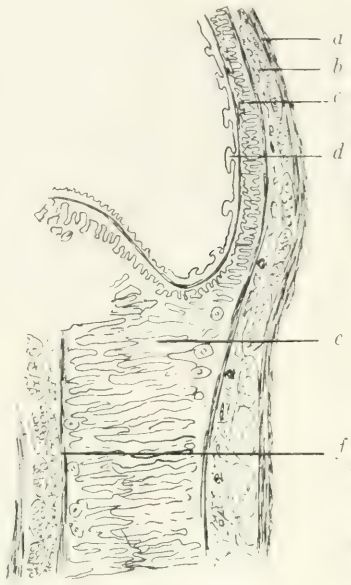


Fig. 2.



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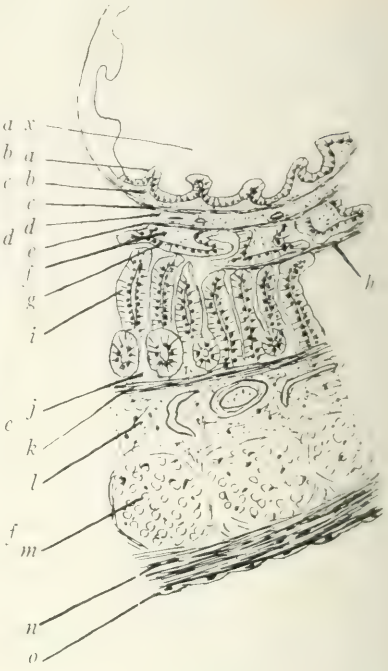


Fig. 4.

Fig. 2. Diagram of tissue removed at operation; a longitudinal section through intestine and two cysts. *a*, Oral end of specimen; *b*, longitudinal muscle of intestine; *c*, circular muscle of intestine; *d*, mucosa (villi) of intestine; *e*, epithelial villi, resting on muscularis mucosæ and *covering* cyst wall; *f*, columnar epithelium, in papillary folds resting on muscularis mucosæ and *lining* cyst cavity; *g*, area sectioned and illustrated in Figure 3; *h*, smaller cyst, enucleated at first stage of operation. Lined by papillomatous and flattened squamous epithelium and having a muscular wall continuous with the musculature of the intestine, but, unlike larger cyst, having no epithelial cover; *i*, opposite walls of intestine, in contact with each other, the villi intimately interwoven; *j*, anal end of specimen; *k*, diagram of probable origin.

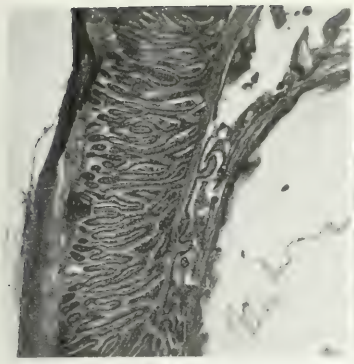
Fig. 3. Semidiagramatic representation of section indicated in Figure 2. *a*, Musculature of intestine; *b*, submucosa of intestine, highly vascular; *c*, villi of intestine, in contact with flattened villi of cyst wall covering; *d*, low papillary folds of epithelium, lining cyst cavity, *e*, opposite walls of intestine in contact, gut lumen quite indistinguishable; *f*, muscularis of opposite intestinal wall.

Fig. 4. Sketch of cyst wall and intestinal wall. *a*, Low columnar epithelium, in papillomatous folds, lining cyst cavity; *b*, tunica propria of cyst lining; *c*, muscularis mucosæ of cyst lining; *d*, submucosa of both cyst lining and cyst covering, fairly vascular; *e*, muscularis mucosæ of cyst covering; *f*, tunica propria of cyst covering, *g*, columnar and cylindrical epithelium (also goblet cells) of the flattened villi of cyst covering, in most places in direct contact with the villi of the intestinal wall, although in places it is separated by a loose fibrinous deposit as indicated at *h*; *i*, epithelium of villi of intestine; *j*, tunica propria of intestine; *k*, muscularis mucosæ of intestine; *l*, highly vascular submucosa of intestine; *m*, circular muscle of intestine; *n*, longitudinal muscle of intestine; *o*, peritoneal covering; *x*, cyst contents, glairy, mucinous, colorless.

meters long, the lumen of which was completely occluded by a cyst which dilated the intestine to a diameter of about 3 centimeters. Below the large cyst (i.e., toward the anal end) in the intestinal wall, opposite the mesenteric attachment, appeared a small surgical wound, obliterated by a catgut suture. The small cyst removed from this site was submitted as a separate specimen.

These two cysts, particularly the larger one in the lumen of the gut, represent a rather unusual and highly interesting type of teratoma, the so-called enteric cyst.

Quoting the German literature (1) exclusively, Ewing (2) says, of these tumors: "Enteric cysts constitute a rather well-defined group of intraperitoneal cysts. They form single or multiple, large or small cysts, lying usually along the lower end of the ileum, in the wall of the intestine, at the point of Meckel's diverticulum (Roth) in the mesentery, or near the navel (Wyss). When originating within the muscular wall of the intestine they usually remain connected with this organ and are enclosed by a muscular wall. Arising in the subserosa, they remain attached to the convex side or project into



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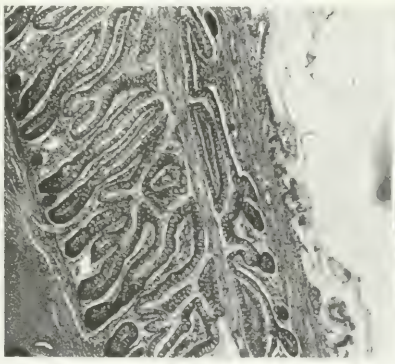

Fig. 6.

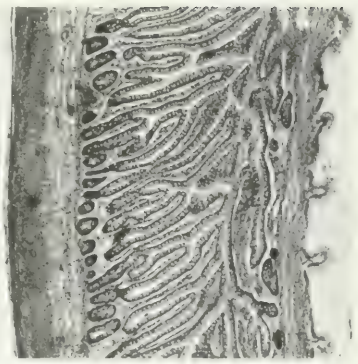

Fig. 7.

Fig. 5. Photomicrograph of intestinal wall and cyst wall, at point of mechanical separation.

Fig. 6. Photomicrograph of intestinal and cyst wall with villi of intestine and cyst covering in direct contact.

Fig. 7. Photomicrograph of intestinal and cyst wall, with a fibrinous deposit between the villi of the intestine and the villi of the cyst covering.

the mesentery. There may be definite malformation of the intestine. The cavity is usually single and the contents are mucinous, colorless, yellowish, or brownish. The wall resembles that of the intestine, and may contain smooth muscle, mucosa, crypts, lymphoid tissue, and a lining of cylindrical, or cuboidal or stratified epithelium (Colmers). The epithelium may show papillary proliferation. . . . There are probably several modes of origin of enteric cysts. Many originate from Meckel's diverticulum and are located at the lower ileum where they may communicate with the bowel (Ruge, Roth). At the navel they may be referred to the omphalomesenteric duct (Wyss). The term "enterodermoid" has been employed by Beneke to designate enteric cysts which arise from definitely misplaced portions of intestine."

Ziegler (3) says: "The cysts arise, in the peritoneal cavity, in part from snared portions of the intestine (enterocyst), in part from portions of the urachus (urachus-cysts). . . . The origin of the cysts lined with cylindrical epithelium can usually be determined only from their position and the character of their walls, but in the majority of the cases the origin can usually be ascertained beyond doubt. The diagnosis can be made with greatest certainty when the misplacement of the separated portion is slight and when the formation still shows clearly the character of the mother-tissue." Referring to secondary changes in these cysts, he says: "From separated portions of the intestinal mucous membrane it is probable that cylindrical celled carcinomata may take their origin."

In the main, this particular specimen is in accord with the above descriptions. The two tumors appear in the wall and in the lumen of the small intestine, at its lower end, though no tumors were found either in the mesentery nor in the intestinal wall at the normal location of Meckel's diverticulum. Nor were any tumors found near the navel. The malformation of the intestine was simply that due to complete obstruction—dilatation of the ileum above the large cyst and utter collapse below the cyst (a collapse so complete probably from the inception of the formation of the intestine, that the lumen of that portion of the gut was almost wholly obliterated, the villi of the opposing walls of the gut being intimately interlaced).

The contents of the larger cyst was a glairy, mucinous, quite tenacious, colorless semiliquid which contained some rather large embryonal type of cells with very small, deeply staining, centrally placed nuclei. The contents of the smaller cyst were lost at operation.

The component tissues of the walls of these two cysts differed rather decidedly. The wall of the small cyst was composed of smooth muscle, in bands that seemed to have no

particular order or arrangement, but being, after a fashion, as nearly as could be determined postoperatively, a continuation of the musculature of the intestine at this point. The lining consisted of a muscularis mucosa on which was mounted a single layer of cuboidal epithelium, shading, however, into flattened squamous epithelium at that portion of the cyst which bulged through the serosa of the gut, and to a papillomatous arrangement of cylindrical cells at that portion of the cyst which projected toward the lumen of the gut. Adherent to the lining epithelium were strands of mucinous material enmeshing many of those large embryonal type of cells, previously mentioned. (Incidentally, these cells were rather uncommon in the larger cyst.)- Below the lining epithelium was a sparse, but highly vascular submucosa. Epithelial cell rests within the wall of the gut, with secondary muscular hyperplasia seems the only hypothesis to explain the origin of this cyst.

The larger cyst—the one which wholly occluded the gut and which gave rise to the fatal symptoms of intestinal obstruction—presented an even more interesting structure on detailed examination. This larger cyst, about the size of a pigeon egg, was roughly ovoid in shape, filled with mucinous material, and presented in the tissues of its wall practically all the tissues of the small intestine, in orderly arrangement, with the addition of strange tissue. From the interior, outward it was shown to be made up of—

1. The lining of squamous, cuboidal but chiefly cylindrical epithelium, in single layer, but thrown up into low papillomatous folds;
2. A tunica propria;
3. A definite muscularis mucosa;
4. A quite vascular submucosa, that might be considered the submucosa of both the lining and the covering of the cyst;
5. A submucosa of the covering, with lymphoid tissue;
6. A tunica propria of the covering;
7. The epithelium of the covering. This consisted of cylindrical cells on a basement membrane arranged in the form of true villi, producing deep crypts. These villi were somewhat flattened, being in contact with the villi of the intestine, and rather broad at their bases. They contained numerous goblet cells. In other words, this layer was a slight modification of normal intestinal mucosa. These villi were in close contact with the villi of the intestine in most places, though in others a deposition of fibrous tissue had been laid down separating the epithelium of the cyst wall from the epithelium of the gut wall.
8. Continuing outward, the tissues of the gut were found to consist of normal tissues, normally arranged—epithelial villi, tunica propria, muscularis mucosa, a very vascular submucosa, circular and longitudinal muscle fibers and endothelium. The plicæ circulares seemed somewhat redundant.

The intestine below the site of the obstruction (the cyst had probably functioned as an obstruction since very early embryonal life) presented the unusual appearance of having the villi of opposing walls of the gut intimately interwoven, so that it was practically impossible to discover what would have been the lumen of the gut, until the sections were teased apart. Here too, the plicæ circulares seemed quite redundant.

To postulate an early embryonal misplacement of entodermal epithelial cells in the wall of the gut, with their subsequent secretions forming a cyst, seems necessary to explain the origin of this tumor. The gradual bulging of this cystic mass, this "neoplastic plica circulares or valvula conniventes" might then become sufficient to create an obstruction large enough to occlude the lumen of the gut, receiving its nourishment through a very fine, short pedicle from the gut wall. Such a process could go to completion without the production of symptoms only in the fetus. While we have not been able definitely to demonstrate this pedicle of origin, such an explanation satisfactorily accounts for the cysts and their complicated structure.

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CONGENITAL CYST OF THE DUODENUM

Report of a Case

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IN medical literature there are surprisingly few references to congenital cysts of the gastro-intestinal tract. Apart from Meckel's diverticulum, the most frequent site of congenital abnormalities in the small intestine is the duodenum; such abnormalities are usually atresias.

Meyer (1), in reporting a case in many respects similar to the one herein described, reviews the literature on this subject. Much of what follows is taken from his paper. Lexer's (2) case was described as representing a bigerminal implantation; Sanger and Klopp (3), in reporting a case of multiple cysts, classify such cysts in three groups: (a) cysts of the accessory liver, (b) cysts of the accessory bile duct. (c). In this group they assume, contrary to Roth, that the cysts originate through a lateral construction of a piece of intestinal anlage, occurring above the omphalomesenteric duct. These lateral constrictions become separated from the main tube of the intestine and, unhampered by the outgrowths of intestinal loops, they remain near the diverticulum and are thus formed from the duodenum. Meyer concludes that his cyst belongs to group (c).

Gfeller (4) calls these tumors entodermoids because they originate from the entoderm. Beneke (5) had already used the term, but in a narrower sense, to distinguish between those cysts originating from aberrant nuclei of the intestinal tube and those developed from the remains of the omphalomesenteric duct, to which he limits the term "enterocystoma." In addition to the above literature on enterocystoma, Meyer mentions that Puschmann, Buchwald, Anderson, and Nasse have described cases showing characteristics similar to those of his case, and he states that if the names of Kuzmick, Levy, Roenger, and Sprengel be added to this list, the literature on the subject is practically exhausted.

Lewis and Thyng (6) found that intestinal and bile duct diverticula occur regularly in the embryos of the pig, rabbit, and man, also in the cat and sheep. They state that they usually degenerate, sometimes forming detached cysts.

The term "enterocystoma," as used by Rokitansky, corresponds to the definition given by Roth: "A congenital cyst is one the wall of which corresponds more or less completely to the structure of the intestinal canal, and the genesis of which is referable to irregular development of the intestinal tube." Undoubtedly, the tumor this description usually fits is the omphalomesenteric cyst, formed by the irregular closure of the omphalomesenteric duct.

Classification, up to the present, includes (1) Sanger and Klopp's three groups, (2) entodermoids, and (3) enterocystomata—enterocystomata as a term including all of these.

The case herewith described has certainly no relation to the omphalomesenteric duct, but, I think, may be classified as an enterocystoma, in its broadest sense, of the duodenum.

G. A., female, age 19 days, born of Icelandic parents in the obstetrical ward of the Winnipeg General Hospital, January 9, 1922. It was an unusually easy confinement for a primipara at term. Both were discharged from hospital on January 19, in good condition. Almost as soon as the mother went home she noticed that the baby began to regurgitate a little milk after each breast feeding. The regurgitation soon increased in amount and came on immediately after each feeding. Sleep at first was undisturbed, but as hunger increased from the continued regurgitation crying became continuous. The bowel movements became irregular, the baby lost weight, and, on January 28, she was brought to the Winnipeg General Hospital, as the mother by this time was convinced that all food taken was vomited. The bowels had not moved since January 26—2 days. The baby was immediately admitted to the hospital and soon after admission passed a small, normal looking stool. The history of recent passage of flatus was in-

definite. A bowel irrigation brought away a small, normal looking stool. All food was vomited precipitately as soon as taken. Temperature 98.6; pulse 100; respiration 35. Diagnosis by the physician sending the case to the hospital was intussusception.

Physical examination revealed a baby who had lost a moderate amount of weight. Crying was continuous. The abdomen was slightly distended and somewhat more prominence was seen in the right hypochondrium than elsewhere. It was difficult to palpate the abdomen on account of crying, but it did not seem to be tender, and on inspiration was quite soft all over. A firm, indefinitely rounded mass could be palpated on the right side of the abdomen extending from the iliac fossa to the costal margin and across the right hypochondrium to the mid line. A tympanitic note could be elicited over the whole abdomen. Rectal examination was negative. Leucocyte count, 8,200. On examination under an anæsthetic the abdomen was found to be quite soft, and in the region described above an even, firm, rounded mass could be felt extending from a little below the crest of the ilium to the inferior surface of the right lobe of the liver and reaching to, but not across, the mid line. The baby obviously had a high obstruction of the bowel, with no peritonitis. The nature of the mass was problematical; it seemed too large and not firm enough for a hypertrophied pylorus. Its shape, comparative lack of constitutional symptoms, and absence of any signs in the stools were against an intussusception. Of congenital deformities, the possibility of a tumor in the right hypochondrium, obstructing the duodenum by its pressure, suggested itself, but no definite opinion as to the nature of this tumor could be formed.

Operation, January 28. The abdomen was opened through the right rectus muscle above the umbilicus. Both large and small bowel were normal, showing that the obstruction was not complete. The gall bladder was normal. Presenting on the outer side of the colon was a cystic mass about the size of a tangerine orange, displacing the ascending colon, hepatic flexure and transverse colon forward. No evidence of peritonitis was present. The peritoneum on the outer side of the hepatic flexure was incised, and a cyst, which was definitely retroperitoneal, was shelled out as far as the mid line, where it was found to be intimately connected with the posterior wall of the duodenum and abutting against the head of the pancreas. As the duodenum was followed downward from the pylorus, it was seen that the first part seemed to run into the upper aspect of the cyst and the third part to emerge from the lower part. The intervening portion of duodenum was discerned, on close examination, to be stretched like a ribbon across the anteromedial aspect of the cyst wall. The association between the cyst and the duodenum was so intimate that it was impossible to think of dissecting them apart. The cyst itself was semitransparent, like a hydrocele. The pressure of the cyst on the first and second parts of the duodenum was obviously the cause of the obstructive symptoms. A small incision was made in the wall of the cyst on its outer aspect, well away from the duodenum, and a clear, straw-colored fluid evacuated. The cavity of the cyst did not communicate with the lumen of the bowel. After excising a small portion of the cyst wall at the site of this incision, for examination, the cavity was packed with gauze. The abdomen was closed with through-and-through sutures and the strip of gauze packing secured.

The packing was removed on February 2, and a tube inserted into the cyst cavity. On February 6, the tube was forced out some time between dressings, and the sinus could not be found to reinsert it, so it was left out. The discharge was never copious and never bile-stained. Recovery was interrupted by occasional attacks of vomiting after food, but this gradually ceased and the baby was discharged in good condition on March 8, weighing 7½ pounds, a gain of half a pound since admission.

Dr. Boyd, the pathologist, reported on the fluid from the cyst and the specimen from the wall of the cyst as follows: "Fluid. No bile, no urea, and no ecchinococcus hooklets present. Tissue. This consists of a well-marked inner circular and outer longitudinal muscular coat."

On March 15, 1922, the child was readmitted with symptoms similar to those present in January, but not so severe. A small mass was palpable in the abdomen where the cyst had been. Added to this there was present a very severe acute bronchitis. Temperature 103.5 degrees; pulse 130; respiration 40. There was evidently a recurrence of the former condition, but the chest complication made surgical interference very unsafe. Operation was delayed until March 22, when it was apparent that the baby was going down hill rapidly from the gastro-intestinal obstruction, and the chest condition was only slightly improved. The extreme gravity of the case was explained to the parents, and they wished the operation to be done.

Operation March 22. The abdomen was opened through the old incision and a recurrence of the cyst found. The cyst was evacuated as before and its wall sutured to the aponeurosis of the abdominal wall, a tube inserted into the cavity and the abdomen closed with through-and-through sutures.

The baby became rapidly worse and died of bronchopneumonia on March 28, 1922. Postmortem examination was not permitted by the parents; indeed, the body was removed from the hospital with such dispatch that there was not even an opportunity to explore the affected region through the wound of operation.

The observations at operation were necessarily hurried. At the first operation, when the discovery was made that it was impossible to separate the cyst from the duodenum with

any degree of safety, no attempt was made to separate it from the head of the pancreas, but it was concluded that the condition being dealt with was that of a congenital pancreatic cyst and it was treated as such. If at that time the cyst wall had been sutured to the abdominal aponeurosis, I feel sure that the recurrence of the cyst would not have taken place, but as this seemed to involve considerable deformation of the duodenum it was decided merely to pack the cavity.

The pathological report on the structure of the cyst wall suggests very strongly that the cyst originated in connection with a muscular tube in this vicinity. This forces the consideration of the common bile duct, the pancreatic duct, and the duodenum itself. There is not sufficient evidence to discriminate between these three, except that the thickness of the muscular layers of the cyst wall were almost what one would expect to see in the wall of the small intestine. What is certain is that it was a cyst derived either directly or indirectly from the duodenum. In all probability it resembled the one described by Meyer.

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CONGENITAL HEMIMACROGLOSSIA, WITH DISTURBANCE OF THE LOCOMOTOR APPARATUS OF THE SIDE OPPOSITE THE LINGUAL LESION.

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AFTER having made in several languages, numerous bibliographic researches on the subject of which I am about to treat in this communication, I believe that I may say that the following observation is unique of its kind. If we know that the acquired macroglossia manifests itself as the result of inflammatory lesions of the tongue, diathesic or others, it is not the same with regard to congenital macroglossia, the cause of which has always been unknown to us. My patient was very interesting from several points of view, in the sense that the case was one of congenital hemimacroglossia, accompanied by hypertrophy of the corresponding cheek, and troubles of the locomotor apparatus of the side opposite the lingual lesion. This association of symptoms particularly attracted my attention, up to the point of inducing me to advance a hypothesis to explain by a unique lesion, all the phenomena observed. The history of my patient follows.

On November 26, 1919, Mrs. C. L. who came from Gaspe, asked me to make an examination of her daughter, three and one-half years of age, for a lingual affection dating back to childbirth. She informed me that at that time her baby weighed 12½ pounds and that although the doctor was not obliged to apply the forceps or to practice version, the confinement was very laborious. The cord, very voluminous, was long and rolled around the neck. The face was cyanosed, and the tongue, blackish in color, hung out of the mouth. In order to reanimate the infant, the doctor had to resort to artificial respiration for several minutes. The left cheek was more developed than the right, and it fell lightly on the corresponding lower jaw. There existed certain phenomena of atrophy and paralysis of the upper and lower limbs of the right side which, for the present I leave to the appreciation of the consulting physician. During the five following weeks, the tongue slowly diminished in size and recovered its normal color. However, always very large, it protruded from the lips for about 2 centimeters, and after a lapse of time that condition seemed to remain stationary. The left cheek also became smaller by degrees, but remained projected a little more than the right. The child took the breast with some difficulty.

Six weeks after the birth of the child, the parents went to consult Dr. Mireault, orthopedist of Montreal, who was at that time holding his summer clinic on the shores of the Gulf of St. Lawrence, and sought advice in relation to their infant's hemiplegic trouble. My excellent confrère, who subsequently sent his little patient to me for the lingual treatment, was good enough to furnish me with the following notes in relation to his specialty.

"At the examination, I noticed that the upper limb and the lower limb of the right side were smaller and shorter than those of the opposite side, which were normal. The arm rested inert along the body, and the leg was without movement. The tissues lacked firmness in the paralyzed regions.

"In that part of Canada, nature offers the greatest advantages for the restoration of health, but civilization has not yet carried its progress there; hence we have not yet the assistance of electricity there, either for diagnosis or for treatment.

"The doctor who assisted at the confinement, and whom I met a few days after my first examination, declared to me that he did not find granulations in the membranes, or placental tissue.

"The father and mother, who were both about 30 years of age, are in excellent health, and do not indulge in alcoholic liquors.

"There does not seem to be either syphilis or tuberculosis in their family.

"They have two other children, both in good health, and whose confinements were normal.

"In face of these symptoms, once a week, I carried on massage accompanied by passive movements of the paralyzed limbs. This treatment was practiced for 3 months, and at the end of that period, a slight mobility manifested itself. The following year I noticed a progressive amelioration. The child could now move the arm and leg. However, these limbs had not yet attained the vigor of those on the opposite side. During this season, as well as during the two following summers, massage and passive movements were continued. I noticed a gradual diminution of the troubles of the locomotor apparatus to the right. The child commenced to walk at the age of 18 months, and when 3½ years old, could run and jump. However, her walking is a little defective, for there is a slight lameness. During the whole period of her orthopedic treatment, I never observed spasms or contractions, and the articular movements were executed in their normal amplitude and without pain. There always existed a slight shortening of the right arm and leg, as well as a certain degree of atrophy. These phenomena, with a little natural feebleness of the arm, will be permanent in the future. The tongue and cheek are the only two parts whose condition seems to have remained stationary during the last 3 years."

At my examination, I ascertained, in addition to the symptoms already described, that this girl, having always breathed the pure and saline air of the Gulf of the St. Lawrence, is for her age perfectly developed. The skull, of ordinary size, is well formed, and the child's intelligence is above the average.

Her mother informed me that from time to time the child had sudden changes of humor, and even violent fits of temper. However, these cerebral phenomena are becoming less and less frequent. She has never had convulsions.

The left cheek is a little larger than the right, at the same time, being very firm. There is no facial paralysis. The pupils are normal and there is no nystagmus. The hearing is excellent on both sides. The tongue, very thick on the left side, is deviated to the right, and constantly hangs out of the dental arcades to a length of nearly 2 centimeters. Its hypertrophy is uniquely localized on the left side, and continues to the base. Of normal color, it is a little rough to the left, and presents on that side a firmer consistence than on the other. There are no sublingual varicose veins, and the teeth have not produced any ulceration. The inferior lip is lowered without being increased in size. The teeth are well implanted, and the gums show nothing out of the ordinary. The submaxillary glands are not hypertrophied.

The parents have never attempted to force the tongue back into the child's mouth and hold it there by means of a bandage. Moreover, that organ could not be contained in the buccal cavity. Saliva oozes from the mouth slowly. There is no paralysis of the muscles of the tongue, and the taste seems to be normal on both sides. No pain has ever been felt. The tonsils have not increased in size, and nasal respiration is excellent. The roof of the mouth is normal. Mastication is strongly impeded, but swallowing is accomplished relatively well. Phonation is a little troublesome.

In presence of this congenital hemimacroglossia, which seemed to have remained in a stationary condition for 3 years, I immediately proposed the ablation of a part of the hypertrophy as being the most rational treatment. The accepted intervention was fixed for November 29.

Operation. The little patient was put under the influence of chloroform, and I immobilized the dental arcades with a mouth-gag. The tongue-forceps were afterward applied to the end of the tongue—one of them being held by an assistant—and after having practiced a light traction, I divided the organ by means of a pair of scissors for the length of about 5 centimeters in following the middle raphe to the left. Once the tongue was separated in two, the affected side being longer than the healthy side, I removed a V-shaped piece in order to re-establish the symmetry. The section commenced on the left external part, at a certain distance from the tip, and continued toward the base on a line of 4 centimeters. After having controlled the hæmorrhage, which was insignificant, I made a series of sutures commencing at the wound on the floor of the mouth. When all the points were placed, I applied a last transversal suture having the form of a U

properly to coapt the middle part. At this time the tongue entered the mouth perfectly, and its tip, which was drawn neither to one side nor the other, maintained its regular anatomical design.

As a buccal antiseptic, I prescribed a solution of resorcin to be used with an atomizer.

The outcome of the operation was normal, and after several days of lingual reaction, the œdema disappeared gradually. I commenced to make the ablation of the sutures at the end of the first week, and on the eleventh day, they were all removed. Three weeks after the intervention, the girl, thoroughly re-established, returned home with her mother. The left side of the tongue was still a little larger than the right; however, its volume diminished little by little.

The anatomo-pathological examination of the piece that was removed showed that we were in the presence of a hemimacroglossia of lymphatic form —a microscopic variety most generally observed in this kind of lesion of congenital macroglossia.

From time to time I received news of my little patient, and in June, 1922, the left cheek was of almost equal volume to that of the right cheek. The left side of the tongue was slightly larger than the right; however, it was quite mobile and easily contained in the mouth. Considering the age of the child, her pronunciation was as good as could be expected, and her temper was improved.

As it is now a little more than 2½ years since the operation was performed, I have every reason to believe that there will not be any relapse of the lingual affection.

The upper and lower limbs of the right side are still slightly shorter than those of the left, and at the same time present a little atrophy. These troubles will never wholly disappear in the future.

To sum up the case, a child, born of parents enjoying the best of health, without any diathesis, has at birth a hemimacroglossia to the left, accompanied by hypertrophy of the corresponding cheek, and paralytic phenomena of the locomotor apparatus on the side opposite to the lingual lesion. After the operation the tongue and cheek returned to an almost normal condition, but the motor troubles of arm and leg, though very considerably improved, did not entirely disappear.

If now we stop to consider the cause of this strange disease, we see that in the orthopedic domain the etiological factors of the locomotor troubles of newborn children can give rise to very different interpretations, according to their localization.

Lesions of the nervous system are more serious than articular lesions, and the contusions of the muscles do not give a prognosis as serious as in the case of epiphyseal tearing. Affections of newborn children resulting from abnormal conditions during the intra-uterine life manifest themselves at birth, or in the first days after confinement. Tissues in the course of growth are very vulnerable, and their power of resistance is less during intra-uterine development than on the nursing child.

Our slight knowledge of fetal life does not give us an entire comprehension of abnormal phenomena, mechanical or nutritive, which have for result a being infirm or deformed when brought into the world.

There are three classical types of congenital paralysis. The whole three affect only the arm. The first paralysis attacks the entire arm; the second, that of Klumpke, settles in the forearm; and the third, the paralysis of Erb, occupies the upper region, the latter kind being much more frequent. But apart from the present instance, we have never yet observed a case of congenital paralysis of the lower limb.

The totally transitory paralytic character of the troubles of the patient in this case, inclines me toward two etiological factors: either a bulbar capillary hæmorrhage, or in the nervous trunks: or else a traumatism of the articular capsules due to a slight and prolonged traction on that membrane by an exaggerated flexion during the last days of intra-uterine life. Nevertheless, I must say that the arm and leg both participated in the state of paralysis, that there was neither contractions nor bad positions of the limbs, and that symptoms of pain were absent.

As to epiphyseal tearing, it must be eliminated.

The cause of congenital macroglossia is not yet known.

In my case, I believe the hemimacroglossia can be attributed to the same etiological factor as the affection of the locomotor apparatus. Indeed, if we had been in the presence of a cerebral lesion, there would have been the phenomena of contraction, pain, and sensory

troubles. None of these was present, and more than that the intelligence remained lively, the character became normal, and physical development followed the ordinary course of growth.

With a meningeal œdema, there would probably have been persistent lesions being connected with a diathesis.

Consequently, in the presence of the association of symptoms observed in the case of my little patient, I consider I found sufficient elements to justify the hypothesis of a bulbar capillary hæmorrhage in the region of the nuclei of the seventh, twelfth, and ninth cranial nerves on the left side, a lesion which determined trophic disturbance of the tongue and cheek, accompanied by divers troubles, transitory or permanent, of the upper and lower limbs on the side opposite the lingual affection.

CHANGES OF PRESSURE INSIDE THE FETAL CRANIOVERTEBRAL CAVITY

By BRONSON CROTHERS, M.D., Boston

IN 1861 Little presented clinical evidence to support a theory that some of the mental and physical defects of children were due to injuries of the central nervous system during delivery. This evidence has never been challenged and no one now questions that a considerable proportion of all the defective and crippled children who fill institutions and form a discouraging group in every out-patient department owe their disabilities to accidents during birth.

Furthermore, it is unnecessary to call attention to the fact that babies can be killed by efforts to deliver them by force through passages too narrow to allow spontaneous expulsion. The possibility that accidents may occur under conditions producing recognized dystocia is admitted. The fact which has not received general recognition is that babies can be, and frequently are, seriously and even fatally injured even if the forces used in delivery are well within what are regarded as normal limits.

In this paper I wish to present the evidence which has convinced me that the process of successful childbirth depends, to a very great extent at least, upon the preservation of barriers which prevent the forces imposed upon the fetus from injuring the central nervous system. In normal labor pressure is controlled so that danger is averted. Unusual forces, chiefly due to abnormal conditions or to obstetrical interference, may break down certain barriers which usually control pressure in an orderly way. The discussion which follows is limited to conditions generally regarded as normal. That is, I assume that the fetus is at term, that there is no serious disproportion between the size of the fetus and the pelvic canal, that the mother is strong and is threatened by no condition which forces the attendant to interfere in her interest. I also assume that the presentation is either vertex or breech.

THE CONDITION KNOWN AS ASPHYXIA NEONATORUM

Babies sometimes perish during or shortly after delivery. The discovery of the causes of such disasters is of cardinal importance. The conventional explanation, upon which obstetrical procedure appears to be based, is that the majority of babies die of asphyxia. Therefore, as soon as signs of fetal distress are observed the obstetrician interferes in order to deliver the baby before it is suffocated. This procedure is perfectly logical if either of two facts is known: First, there might be evidence that fetal life is frequently saved because delivery is hastened. This evidence is almost impossible to gather because no sensible operator would be justified

in disregarding accepted traditions in order to observe possible results. Second, the strong probability of asphyxia might be demonstrated. This problem could, of course, be worked out by a suitable series of experiments which would establish standards of resistance of fetal cells to varying tensions of oxygen and of carbon dioxide. It would then be a relatively simple matter to find out whether the blood of babies, believed to be asphyxiated, showed chemical changes consistent with the diagnosis. As far as I know such studies have not been attempted.

The obstetrical conception of asphyxia appears to rest entirely upon speculations and deductions. Neither in books nor in conversation with obstetricians have I been able to find references to any scientific data which bear upon the subject. Naturally if placental circulation is cut off and the baby is left inside the uterus for an indefinite time, asphyxia may be assumed, just as it may be assumed that any tissue will eventually die if it is deprived of oxygen supply. The question at issue, however, is not so simple. It is, will a fetus possessing an independent and functioning apparatus for circulating its supply of blood, perish from asphyxia, under conditions met with during birth, if the placental circulation is cut off for a period of a relatively few minutes? As a matter of fact a further question is perfectly legitimate. Is there evidence that the placental circulation is cut off in all, or almost all, of the babies where the diagnosis of asphyxia is made? Two quotations from standard textbooks may be given. The first describes the conditions one author includes under asphyxia. The second shows the explanation which another author relies on in supporting his theory.

Edgar defines the condition as follows: "Blue asphyxia is characterized clinically by a livid redness or blueness of the face and upper parts of the body. The face is turgescent and the eyelids are prominent and injected. The muscles of the extremities, neck, and jaws are rigid, and the heart action is strong. In children thus born the cord is found to pulsate strongly. The reflexes and sphincters behave in a normal manner. Children born with blue asphyxia may recover promptly or only after a considerable interval, or the condition may pass into the white or anamic form. Here the condition superficialy present in blue asphyxia appears to be inverted. The surface is pale, instead of livid. The face is pinched. The muscles are all relaxed. Circulation is at a standstill, and not only is the heart beat difficult to recognize, but there is no escape of blood when the surface is incised. Children born with white asphyxia have a small, almost pulseless cord."

Williams states that the normal supply of properly aerated blood may be cut off by any one of various accidents while the child is still in the uterus or the pelvis. "As a result of the action of any of these factors, the child may take its first breath while still in the uterus or in the lower portion of the birth canal. In the former case it draws a certain quantity of amniotic fluid into its lungs, unless such an eventuality is rendered impossible by the fact that the nose and mouth are closely applied to the uterine wall or are covered by the fetal membranes. When respiration begins while the head is in the vagina, a certain amount of mucus is liable to be aspirated. In either event the needed oxygen is not obtained, and the resulting air hunger leads to increased respiratory efforts which are nevertheless of no avail. Gradually the accumulation of carbon dioxide and other excrementitious materials in the fetal organism leads to such a pronounced decrease in the irritability of the medulla, that eventually the attempts at respiration cease, the intervals between the pulsations of the heart become longer and longer, and the child dies from asphyxia.

"Again pressure exerted upon the brain in difficult labors and operative procedures may lead to vagus irritation and consequent slowing of the heart. As a result of the interference with the fetal circulation, the blood becomes poorer in oxygen and richer in excrementitious material; this goes on until at last the irritability of the medulla becomes so lowered that the usual stimuli fail to call forth the first respiratory movement and asphyxia results."

It is quite evident that the single point of resemblance between blue asphyxia and white

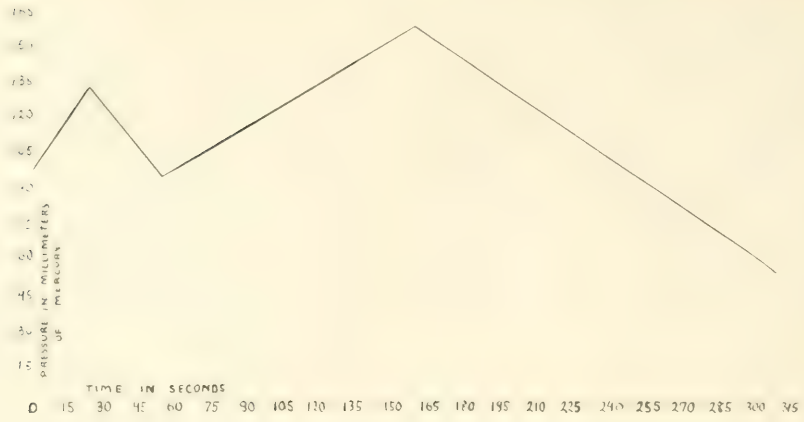

Fig. 1. Blood pressure after experimental occlusion of cerebral circulation. (From Stewart, Guthrie, Burns, and Pike.)

asphyxia is the fact that in both cases the babies are apnœic. Of course perfectly normal new-born babies, of ordinary color, are often apnœic for some time. It is worth while to consider for a moment what logical explanations, aside from those stated by Williams, can be given for failure to take a first breath after delivery. One obvious way to reduce the excitability of the medulla is to give certain drugs, notably opium or anæsthetics. Naturally such drugs given to the mother during delivery might account for certain cases of apnœa in the fetus. But by far the most certain method of producing lack of irritability of the medulla is to attack it directly in any one of a number of ways. The simplest is by direct injury or by increasing pressure in its vicinity so that the circulation about it is cut off. An equally effective method is to shut off circulation by ligation of vessels.

Obviously experiments which produce apnœa in animals after respiration is established are not conducted under circumstances identical with conditions which prevent fetal animals from starting to breathe, but they are at least comparable.

Blue asphyxia, as I understand it, is readily enough explained. The baby, for any one of a number of reasons, has a medulla which is less irritable than usual. As a result it requires more stimulation before taking a breath. This stimulation is automatically provided, as the carbon dioxide increases and the oxygen diminishes, until respiration starts. Apparently uncomplicated blue asphyxia is not usually serious. White asphyxia, on the other hand, is a condition which occurs at no stage of suffocation in extra-uterine life. It can be almost exactly duplicated, however, by interference with the medulla or the phrenic nuclei. The clearest description of the results of putting the medulla out of action is given by Stewart, Guthrie, Burns, and Pike. They rendered the brain and upper cord totally anæmic by suitable arterial ligations,—as a result "the nose and the mucosa of the mouth become white as in death, respiration ceases, the reflexes disappear and the pupils dilate completely. The art is but little affected," the blood pressure first rises and then falls to a low level for the duration of the experiment. (Fig. 1.)

The observations of Stewart, Guthrie, Burns, and Pike and those of Gomez and Pike indicate that the cells of the cerebral cortex resist total anoxæmia for about 10 minutes and those of the medulla for 20 minutes. Cannon and Birket demonstrated that the nerve cells of the myenteric plexus survived and were functionally undamaged after total anæmia lasting for hours. All these experiments were made on adult animals. In the light of Crile and Dolley's work, it is reasonable to suppose that the tissues of young animals are even more resistant.

As I shall attempt to show, the viability of the fetus depends on the integrity of the cells of the medulla and upper cord. If this assumption is valid it follows that the fetus can survive after at least 20 minutes of complete anoxæmia, for it is generally recognized that the other vital tissues survive longer than those of the central nervous system.

THE FORCES IMPOSED UPON THE FETUS

The evidence which I wish to present consists of pathological, physiological, and clinical observations. The injuries at birth are, of course, due to the failure of fetal tissue to resist the forces imposed upon it. It is, therefore, necessary to consider the forces involved and the resistance of the fetal structures upon which they act. The forces are well understood. In normal vertex deliveries, the head is driven into the pelvis and against the more or less rigid soft parts. The only force is pressure. Until the rupture of the membranes, this pressure is uniform; after the escape of the amniotic fluid there is, of course, a distinct difference between the pressure over the portion of the fetus within the uterus and that occupying the os. This difference leads to the formation of the caput succedaneum.

If delay occurs the pressure from above is reinforced by artificial aid. The use of forceps must add a little to the compression of the head. In general, however, it is presumably possible to use forceps without introducing any new type of force. In spontaneous breech deliveries the maternal force is pressure as before. The head, instead of molding slowly, comes suddenly to the superior strait and is forced through it without preliminary adjustment. On theoretical grounds, trouble would be expected. Practically there is good reason to regard breech presentations as dangerous. The forces which are brought to bear, if delay renders interference desirable, are two: First, direct pressure upon the fetal head. This suprapubic pressure is often intense and may be exerted continously over a considerable period. In addition, traction upon the legs or the body of the fetus may be applied. Traction is a totally unphysiological procedure, exerted on tissues ordinarily subjected to compression.

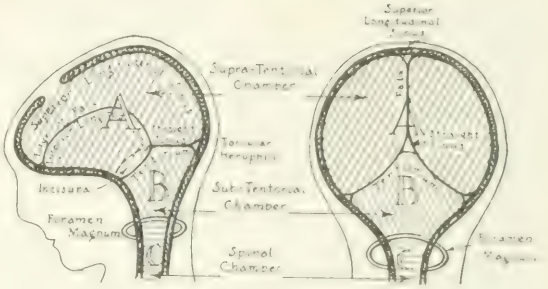

Fig. 2. Sagittal and coronal sections to show venous channels and arrangement of dural septa.

THE FETAL STRUCTURES SUBJECTED TO STRESS IN DELIVERY

The fetal cranium consists of two divisions which are quite distinct from the point of view of resistance to the forces of labor. The flexible plates of bone forming the vault are loosely bound together and form an elastic covering for the cerebrum. The base, on the other hand, is relatively rigid and essentially incompressible. It is easy to demonstrate this difference on any fetal cadaver. The details of this and of other mechanical factors are adequately given by Holland. (Fig. 2.)

The intracranial cavity is divided into three chambers by the dural septa. The cerebral hemispheres are partially separated by the falx which sweeps back from the crista galli of the ethmoid to a strong insertion in the median line of the tentorium. The tentorium forms a sharply pitched roof for the posterior fossa. It arises along the line where the flexible plates forming the vault meet the rigid bones of the base. It is pierced by the opening occupied by the mid brain. The falx and the tentorium may be considered in any one of three different ways: First, as membranes carrying blood vessels. Practically every large venous channel runs along the insertion or through the substance of one or the other membrane. Second, as Holland clearly points out, as strong double layers of fibrous tissue reinforced by bands of fibers which are put under tension as soon as the head is changed in shape; they thus resist cranial distortion. Third, as means to control intracranial pressure.

The spinal column of the infant is composed of a series of cartilaginous, elastic rings held

together by relatively inelastic and fragile ligaments. The elaborate and strong interlocking bony processes of the adult spinal column are undeveloped. The length of the column can be altered about 2 inches by stretching or compressing the fetus between the hands.

The spinal dura is adherent to the vertebræ in the cervical and lumbar regions, while between the two it is almost unsupported except by slender bands of connective tissue accompanying the fragile thoracic roots. These various structures form the walls of the craniovertebral cavity. Above, the two supratentorial cavities, separated by the incomplete septum of the falx, are compressible to a very marked degree. The subtentorial chamber is small, and almost fixed in size and shape. No serious change in its capacity can occur unless ruptures of the falx or the tentorium allow collapse of its roof. The spinal chamber is an extensible tube, the caliber of which cannot be appreciably diminished because it is held to the walls of the vertebral canal by fibrous bands.

The supratentorial contents consist of the two cerebral hemispheres. These masses of gelatinous material contain a small amount of ventricular fluid. The opening in the tentorium is almost completely filled by the mid brain. The posterior fossa contains the pons, cerebellum, and medulla. The relations of the medulla and cerebellum to the foramen magnum are of particular interest. Under ordinary conditions, the medulla and cerebellum are kept from contact with the margins of the foramen by fluid in the subarachnoid space, which is dilated to form the cisterna magna. The foramen itself is slightly larger than the medulla. The spinal cord is continuous with the medulla. In the neck it is supported by the strong, horizontal, closely spaced roots of the brachial plexus. The cauda equina forms a powerful lower anchorage. Between the two fixed points, the slender thoracic cord is supported by the thin oblique roots of the thoracic nerves.

PHYSIOLOGICAL CONSIDERATIONS

The various portions of the central nervous system are of very different value as far as the maintenance of life is concerned. Certain routine physiological experiments will illustrate this point. An animal can be decerebrated by section at the mid brain. The animal lives indefinitely without artificial respiration. From such a decerebrate preparation, the cerebellum can be removed without causing death. However, if the medulla is injured, even by as slight an accident as leakage of blood around it, respiration may cease. In general any severe injury involving the medulla or the upper segments of the spinal cord is fatal on account of injury to the respiratory centers or the phrenic nuclei. Section of the cord below the level of the phrenic nuclei produces the so-called spinal animal. Reflex activity is possible, though voluntary activity and sensation are abolished below the level of transection.

These observations have a direct bearing upon obstetrical problems. As long as the fetus receives oxygen from the placenta it has no need of a central nervous system. Within a measurable time after the cessation of placental circulation, it must be delivered, or be otherwise provided with air, with an excitable medulla and an intact upper cord. It can survive for an indefinite period without any activity of the lower cord, the cerebellum, or the cerebral hemispheres. The viability of the child, then, depends on its delivery without asphyxial or traumatic damage to the medulla or to the phrenic nuclei.

If the intense and irregular forces imposed upon the vertex of the fetal head reached the medulla without modification that cone of vital tissue would be driven against the anterior margin of the foramen. I believe that the tentorium and the falx serve an important function in preventing this impaction of the medulla.

Leonard Hill published, in 1896, a series of observations which tended to prove that pressure within the craniovertebral cavity was not always uniform. His observations were supported by Cushing and by Wolbach, among others. According to this theory of discontinuity, pressure imposed upon the cerebral hemispheres is partially absorbed by the resistance of the brain tissue. Next it is trans-

mitted to the ventricles. The fluid in the ventricles is displaced and flows into the posterior fossa through the aqueduct. Continued pressure after the evacuation of the ventricles is transmitted to the walls of the supratentorial cavity, of which the tentorium, of course, is one. The cerebral hemispheres no longer transmit pressure according to the laws governing fluid pressure in a rigid container, as there is no considerable amount of free fluid above the tentorium.

The subtentorial chamber is relatively constant in size. However, the initial yielding of the tentorium probably decreases its volume a little. Further, the addition of the appreciable amount of fluid forced from the lateral ventricles adds to the contents of the chamber. The result, of course, is a rise of pressure.

One well-recognized result of intracranial pressure is the descent of the medulla and cerebellum into close contact with the margins of the foramen magnum. This results in narrowing of the subarachnoid spaces between the posterior fossa and the spinal canal. Sudden or severe increase of pressure may result in complete obliteration of the subarachnoid spaces and impaction of the cerebellum and medulla. Under these circumstances the medulla may be injured by contact with the anterior lip of the foramen or rendered inexcitable by anæmia from pressure. A similar result will follow sudden reduction of spinal pressure. This disastrous herniation is seen, occasionally, as a result of lumbar puncture in patients with cerebellar tumors. Without going further into the evidence for discontinuity of pressure, it is enough to point out that, under gross and sudden changes of intracranial tension, the tentorium and the foramen magnum are the two points at which pressure imposed upon the vertex may be modified or completely blocked.

The objections to this theory are obvious. Recent studies of the cerebrospinal fluid have indicated that under ordinary conditions the cerebrospinal fluid pressure is essentially the same as the intracranial pressure. Although the validity of such observations is granted, it is essential to investigate the experimental conditions under which they were made. It is quite clear that data obtained from experiments upon animals with rigid skulls cannot be used, without consideration, in solving problems such as we are considering.

Eyster, who studied the relation of Cheyne-Stokes breathing and intracranial pressure, challenges certain methods of Hill. However, he agrees with him at certain essential points. He has shown that under ordinary experimental conditions pressures become equalized very quickly when fluids are forced into the subarachnoid space. From the point of view of sudden or prolonged pressures, however, his paper contains various pertinent, though incidental, observations. In the first place when, after considerable difficulty, manometers were arranged which registered properly in the various cavities, it was observed that, after supratentorial pressure was imposed, "the pressure over the medulla followed in *a few seconds* the pressure of the entering fluid and a slight pressure remained for a short time over the medulla after removal of the compression over the cortex. When the brain had been submitted to pressure for some time, the agreement between the pressures was not so close, and the pressure that remained over the medulla after the pressure bulb was lowered was increased." (Italics mine.)

Further on he states that "when the intracranial pressure has been kept high for a long period of time the brain may become markedly œdematous. It is possible, under these circumstances, that more or less blocking may occur at the isthmus tentorii cerebelli, or at the craniovertebral junction; the pressure upon the medulla is then indirectly transmitted by crowding the hind brain down into the spinal canal, rather than exerted directly by the compressive fluid. This condition is expressed in the results of the experiments by a lack of the usual close correlation between the effects observed and the relations of intracranial and blood pressure."

That is, he appears to believe, as a result of careful observations under experimental conditions, that pressure even by fluid is not instantly transmitted from chamber to chamber and that definite discontinuity occurs when the intracranial pressure has remained high for some time.

The chief point of physics which is to be considered is this: Fluids completely filling closed rigid containers will transmit pressure equally in all directions and to all points. These conditions are fairly well fulfilled within the craniovertebral canal of animals with rigid skulls and with free communication between the fluids in the various cavities. They are no longer present when the walls of the cavities concerned can be altered in shape and when movement of fluid from chamber to chamber can occur. The technique of Weed and others involved the minimum movement of fluid and the least possible disturbance of physical conditions. Under obstetrical conditions, on the other hand, gross changes of volume and considerable movements of fluid may be assumed. It is almost inconceivable that the compression and molding of the fetal head and the lengthening of the spinal column do not introduce factors which render the direct application of observations under radically different circumstances inadmissible. The very fact that Hill's observations were made on animals subjected to sudden and considerable changes of pressure seems to make them more pertinent than the more delicate experiments of recent writers.

THE PATHOLOGICAL EVIDENCE

The safety of the medulla appears to depend upon the ability of the falx and the tentorium to withstand the forces exerted upon them. The phrenic nuclei are endangered by any injury to the cervical spinal column.

The ruptures of the falx and of the tentorium during childbirth were recognized, at occasional autopsies, many years before Beneke in 1910 called attention to the fact that they were common. Beneke reported many cases and described the various types. The septa usually give way in the neighborhood of the insertion of the falx into the tentorium. The tears may be complete, involving both layers of the tentorium, or partial. Sometimes the free edge of the tentorium gives way, sometimes the tear produces a hole. The falx apparently is rarely torn alone and the free edge never gives way.

Beneke's cases were reported in detail by Pott in 1911. Since then a considerable number of European writers have reported series of cases. Among the best papers are those of Meyer and Hauch and of Holland. By tabulation of these cases totaling about 200, certain facts can be shown. Tears of the dural septa can be discovered, on proper search, in almost half of all babies dying during or within a few months after birth. Usually hæmorrhage accompanies the lesions of the septa. In an important proportion of cases, however, little or no bleeding is found. Some authors found hæmorrhage in only about half the cases, others in 90 per cent. The discrepancies are most easily explained, I think, by the varying degrees of care with which cases were studied. Obviously certain observers regard a rupture as a gross solution of continuity, others include almost microscopic incomplete tears. However, I can confirm, from a very limited series of observations, the fact that tears may be of considerable extent without involving any vessels of importance.

Working from another point of view, it is clear that, in most cases of intracranial hæmorrhage, the source of the bleeding is a torn vessel near a rupture of one or the other of the dural septa. As a matter of fact it is hard to find any other vulnerable vessels of sufficient caliber to cause massive subdural hæmorrhages. Vischer, for instance, performed twenty-one autopsies on babies with intracranial hæmorrhage. In 17, or 80 per cent, he discovered tears of the septa.

The fact of greatest interest, however, is the discovery that about 40 per cent of the ruptures occur in babies delivered feet first. In no article is there anything to suggest that version was used except for conventional indications. It seems fair to assume, therefore, that some 40 per cent of the injuries occurred in 5 per cent of the deliveries, or, to put it differently, that ruptures of the dural septa occur eight times as often in breech babies as in those delivered head first. Holland's statistics, based on 81 cases of rupture, showed that the injury could be found in 88 per cent of dead breech babies born without serious difficulty.

The method by which the injuries are caused seems fairly simple. Experimentally

it is possible to rupture the septa by distortion of the head alone. As Meyer and Hauch showed, rupture is favored if the cavities are packed tightly before distorting the head. Apparently it makes little difference whether pressure is exerted from side to side or from front to back. As long as the head is sharply flexed, the falx is put under even tension. Extension and distortion is apparently the least favorable combination. These observations can be easily repeated on any fetal head. (Fig. 3.)

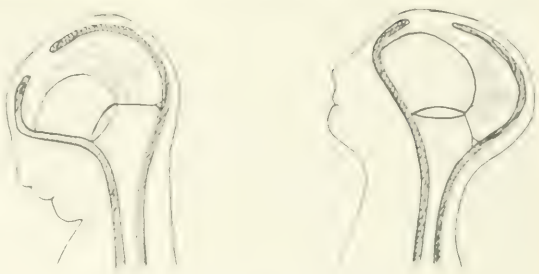

Fig. 3. Diagrams showing the lines of stress in flexion and extension. In extension the incisura is almost horizontal and the strong fibers of the falx are not in the best position to resist strain. At left, flexion; at right, extension.

Beneke made one observation of special interest. He ruptured the tentorium by a sudden blow on the side of the fetal head with a padded hammer. The presumption is that the sudden impact broke the tentorium by much the same mechanism that produces *contrecoup* fractures of the adult skull. A similar manifestation of the importance of impact was seen in an autopsy performed recently at the Neuropathological Department of the Harvard Medical School. A boy of eight was hit on the forehead by an automobile. The skull was not fractured but the tentorium was torn clear into the petrosal sinus.

Meyer and Hauch report one case where a baby was being delivered by cæsarean section. Suddenly the uterus contracted and the head was momentarily caught in the incision. The baby died and a rupture of the tentorium was found.

The relation between rupture and hæmorrhage is important but cannot be considered here. The point I wish to emphasize is that any rupture, however slight, allows the tentorium to descend somewhat, and by just so much decreases the volume of the subtentorial chamber and destroys the rigid barrier to continuity of pressure between the supratentorial and subtentorial chambers. If the rupture occurs early in labor, the medulla is exposed to the direct stress of the irregular forces acting on the fetal head during a considerable period.

The evidence concerning rupture of the spinal column is equally definite, though far less voluminous. C. Ruge, in 1878, reported that 8 out of 64 dead breech babies showed rupture of the cervical spinal column. Scattered reports can be found, but the next considerable series is one by Stoltzenburg in 1911. She found nine cases of rupture of the cervical spinal column out of 75 babies dying of "asphyxia." Eight of these occurred in breech babies. In other words 10 per cent of all the babies dying of "asphyxia" perished as a result of ruptures of the cervical spinal column due to breech extraction. Naturally ruptures of the cervical spinal column are not found unless they are looked for. In this country, at least, the spine is not exposed as a routine in most clinics.

It is obvious, of course, that many cerebral hæmorrhages are not due to dural tears. There is some evidence, however, that even small scattered hæmorrhages throughout the brain may be related to pressure during delivery. This explanation is emphasized by Schwartz. He points out that the caput succedaneum is merely the external manifestation of a movement of fluid which results from the fact that one area of the head is under less pressure than the rest of the fetus. He finds œdema of the tissues, and often hæmorrhage into them, beneath the caput. He has studied a very large number of infant cadavers and reports that in 65 per cent he finds evidence of hæmorrhage, due, in his opinion, to injury at birth.

Traumatic asphyxia, due to compression of the trunk, is interesting in relation to certain injuries in babies. The intense discoloration of the neck and chest, due apparently to capillary stasis, is duplicated in babies. But in babies the delicate blood vessels may rup-

ture, causing intracranial hæmorrhage. This apparently happened in a premature baby described by Ylppö, who, by a series of experiments, established the relation to unequal pressure over head and trunk during labor. Comparison of the plates of his case with those of adult cases presented by Green and by Beach and Cobb is convincing.

If Ylppö's conclusions are correct it is obvious, I think, that compression of the trunk in resuscitation is undesirable. As a matter of fact compression cannot make air enter the lungs until they have been expanded. It is, however, quite probable that many slight intracranial hæmorrhages are increased by active efforts to resuscitate a baby thought to be suffering from suffocation.

The present situation can be summed up as follows: Pathologists have not developed a uniform technique. As their interest focuses on one point, the tentorium, for example, injuries are found in large numbers. If their particular interest is in the study of the phemomena of hæmorrhage, they find that the blood of an extraordinary number of babies is slow in clotting. However, in spite of difficulties in interpreting various articles, it is clear that definite ruptures of the strong dural septa occur in a very important number of cases, that necks are broken with unsuspected frequency in extractions, and that intracranial hæmorrhage, which intelligent and careful pathologists believe to be due to injury, can be found in 65 per cent of all babies dying during labor or in the first months of infancy. However important asphyxia and hæmorrhagic disease may be, for the present there is good reason for feeling that the weight of evidence is in favor of injury as the chief cause of still-birth of viable babies and of death in early infancy.

CLINICAL EVIDENCE

The clinical evidence, of course, is largely indirect. However, certain injuries of the spinal cord produce symptoms so definite that they have a certain value. A study of scattered cases in the literature and one short series I recently reported show that cord injuries follow breech extraction in considerable numbers. The most frequent injury, consistent with life, seems to be in the mid-thoracic region; next come cord lesions resulting from traction upon the brachial plexus.

Beneke made one suggestion in regard to hydrocephalus which is interesting and deserves consideration. He pointed out that hydrocephalus might result from stenosis or thrombosis of the vein of Galen. This suggestion fits in with the experimental observations of Dandy and Blackfan. The latter were able to produce hydrocephalus by ligation, at certain points, of the vein of Galen. They were also able to produce it by placing an irritant ligature around the mid brain. As adhesions blocked the subarachnoid space around the mid brain, hydrocephalus developed. Pathological studies in babies showed that adhesions in this region were frequently present. Dandy and Blackfan believed these adhesions to be the result of meningeal infection. It is possible that some of them were the result of organized blood from tentorial lacerations. Naturally pathological studies with this point in mind will quickly settle the question.

The basal origin of many birth hæmorrhages makes it easier to understand the protean symptomatology of infantile cerebral palsies. The basal ganglia and the mid brain must be frequently involved. Athetosis, flaccidity, and other features of these cases were very difficult to explain on the old theory that the cortex was chiefly affected. In general, therefore, many complicated neurological syndromes in children can be explained on the basis of the pathological lesions which have been recently described. Clinical evidence, such as it is, confirms pathological evidence.

PRESSURES WITHIN THE FETAL CRANIOVERTEBRAL CAVITY DURING NORMAL LABOR

It is possible, I think, to correlate these various observations and to formulate a conception of pressure changes within the craniovertebral cavity of the fetus during labor.

With the onset of labor the fetal head is forced into the pelvic canal. Compression and molding occur. Distortion is limited almost exclusively, to the vault of the cranium. The supratentorial pressure rises, the easily displaced ventricular fluid is forced into the

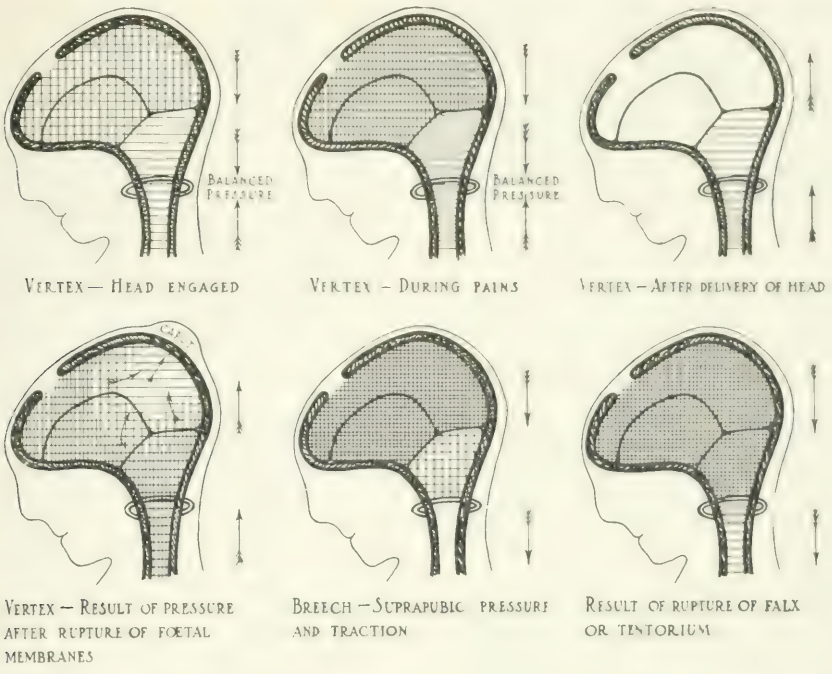
BALANCED PRESSURE
BALANCED PRESSURE
VERTEX — HEAD ENGAGED
VERTEX — DURING PAINS
VERTEX — AFTER DELIVERY OF HEAD
VERTEX — RESULT OF PRESSURE AFTER RUPTURE OF FŒTAL MEMBRANES
BREECH — SUPRAPUBIC PRESSURE AND TRACTION
RESULT OF RUPTURE OF FALX OR TENTORIUM

Fig. 4. Pressures within the craniovertebral cavity of the fetus during normal and abnormal labor. Pressure intensity is suggested by shading; direction of pressure by arrows.

posterior fossa. The cerebral hemispheres no longer contain free fluid and therefore no longer transmit pressure as a fluid. On the other hand any further pressure involves pressure against the walls of the cavity. The vault is forced against the resistant tissues in front of it. The basal bones are rigid. The tentorium alone is relatively fragile and is the only point at which ordinary forces can produce injury.

As the ventricular fluid enters the subtentorial and spinal chambers, pressure is naturally raised. At the same time the forces acting upon the breech cause compression of the spinal column. As a result, a balance of pressure at the foramen occurs. This balanced pressure prevents descent of the contents of the posterior fossa and insures the maintenance of communication between the subtentorial chamber and the spinal chamber. As the pains diminish, the compressed tissues expand and again pressures balance at a lower level. Circulation around the vital cells of the medulla and cord is resumed. Meanwhile the vault is still compressed so that the choroid plexuses can secrete little if any new fluid. As soon as the cervix is fully dilated the rupture of the membranes allows the dilating bag of fluid in front of the head to collapse. New pressure relations need consideration. The part of the head occupying the os uteri is no longer subjected to intrauterine pressure. As a result, the fluids in the fetal body move toward this point. This movement of fluid is manifested by the formation of the œdematous caput succedaneum. Schwartz, who has studied this problem with great care, believes that the caput is merely the external manifestation of a far more important change within the skull.

The successful delivery of a baby who presents head-first, then, depends upon the preservation of the barriers to discontinuity of pressure between the supratentorial and subtentorial chambers and upon avoidance of prolonged or sudden pressures after the rupture of the fetal membranes. The final event, so far as pressures upon the nervous system

are concerned, is the delivery of the head. The flexible plates of the vertex spring back into shape. Supratentorial pressure is relieved. The movement of fluid is upward. The medulla and cerebellum rise from contact with the margins of the foramen, and the baby is neurologically prepared to face an independent existence.

ABNORMAL LABOR

In this paper I purposely omit consideration of recognized types of dystocia due to various abnormal presentations. But I regard breech presentations as abnormal, first, because the fetal death rate is far higher than when the child comes head-first, and, second, because theoretical considerations convince me that dangerous disturbances of pressure are almost inevitable when conventional methods are used in delivery.

The pressure relations during engagement are not radically different from those in babies coming head-first. However, the slow rhythmical compression of the fetal head does not occur. After the breech is born, very definite differences occur. The spinal column is no longer compressed. The head engages very much more abruptly. The ventricles empty suddenly into the subtentorial chamber. As the breech is no longer under pressure, there is no balancing increase of tension in the spinal canal. Downward dislocation of the medulla and cerebellum is, therefore, not automatically prevented. At least, it is obvious that every force is acting downward, that is in the most dangerous direction.

If delay occurs, the obstetrician feels obliged to intervene because the baby is regarded as likely to suffocate. It is argued that the placental circulation is almost certain to be impeded as the engaging head compresses the umbilical cord against the pelvic walls. On the basis of clinical experience certain obstetricians state that delivery must take place within 8 minutes after the head enters the superior strait or fetal asphyxia will cause death. The logical result is early interference.

This interference involves forces which are theoretically dangerous. Traction reduces spinal pressure by elongating the spinal chamber. The arrangement of the fibrous bands attaching the dural sac to the vertebral column prevents corresponding narrowing of its lumen. The result is an increase in the volume of the spinal canal. At the same time suprapubic pressure, often of considerable intensity, is imposed upon the aftercoming head. The downward stream of pressure, inevitable in breech deliveries, is intensified.

Two accidents, both well established by pathological evidence, may occur: first the tentorium may rupture (the suprapubic force is suddenly released upon the medulla); or the cervical spinal column may give way, involving traction upon the vital region of the phrenic nuclei or haemorrhage about it.

Logically disaster threatens the breech baby because the balanced pressures which safeguard the medulla in normal labor are likely to be upset. Pathologically the evidence is clear that injury to the medulla or to the upper cord kills most of the babies who perish. The vigorous use of measures designed to save the child from death by suffocation increases the already great risk of death from injury.

CONCLUSIONS

In this paper the results of the imposition of force upon the fetus during delivery are considered from a neurological and physiological point of view.

The most important lesions, directly referable to force, are: (1) rupture of the falx or the tentorium, and (2) rupture of the cervical spinal column. These lesions are not in themselves fatal, but they expose the medulla and the upper cord to injury.

Under ordinary conditions the medulla is guarded from harmful pressure by the tentorium, which modifies and controls force imposed upon the vertex, and by equilibrium of fluid pressure at the foramen magnum, which prevents downward dislocation of the contents of the posterior fossa. This balance of pressure can be upset and herniation of the cerebellum and medulla produced by rupture of the dural septa or by combinations of forces which maintain or increase intracranial pressure while diminishing spinal pressure.

Breech extraction, as usually performed, brings dangerous and unphysiological forces into play. Pathological evidence shows that

rupture of the tentorium occurs in 88 per cent of the still-births following so-called normal breech labors. In addition a considerable number of injuries of the vertebral column or of the spinal cord can be logically attributed to traction during breech deliveries.

Aside from the gross injuries, which account for about half of the death rate in viable newborn babies, various alterations in pressure during delivery and certain manœuvres during resuscitation may produce fatal or disabling lesions within the central nervous system.

Asphyxia, as commonly described in obstetrical literature, is vaguely defined. Pathological and experimental evidence of its existence is not available. While the absence of proof is not in itself evidence against the obstetrical conception, it invites challenge. The pathological findings, particularly those in babies dying after breech delivery, raise the question whether efforts to avoid fetal asphyxia may not add to the already great risk of injury to the contents of the craniovertebral cavity.

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SPINAL AND CRANIAL INJURIES OF THE BABY IN BREECH DELIVERIES

A Clinical and Pathological Study of Thirty-Eight Cases[1]

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THE purpose of this paper is to add to the accumulating evidence showing that natal or neonatal death in breech deliveries is more often due to the injury and shock from unphysiological extraction, than to asphyxia of the baby caused by interference with placental or umbilical cord circulation.

In estimating the fetal mortality of breech deliveries, textbooks vary from 5 to 30 per cent. However, estimates based on large series of cases are infrequent in the literature. The fetal mortality in viable babies, in primary breech deliveries in the first 20,000 cases at the Sloane Hospital for Women, has been found by Ryder to be 8 per cent. A series of 5,000 deliveries beginning in 1915 showed a mortality of 12 per cent. It is agreed, therefore, that a fetal mortality of from 10 to 15 per cent in such deliveries is conservative.

Why should there be such a high mortality in breech deliveries? Asphyxia is emphasized as the cause of death in nearly every textbook on obstetrics. By asphyxia is meant a general asphyxia of the baby caused by interference with placental or umbilical cord circulation. It is said to express itself at birth as "asphyxia livida" in the less severe cases, and as "asphyxia pallida" in the more severe ones. Its mechanism is described as compression of the umbilical cord between the pelvis of the mother and the aftercoming head of the baby or as premature separation of the placenta. Most authorities suggest that the compression of the cord is complete while the head is passing through the pelvis and that, clinically, a period of complete asphyxia must be considered to exist between the birth of the navel and the mouth. A tradition is expressed in the literature, and exists in most obstetrical clinics, to the effect that this asphyxia cannot be tolerated by the baby for more than from 5 to 8 minutes. In other words, extraction from navel to mouth must be effected in less than 8 minutes or the baby will be lost. Acting on this tradition, it is the custom in many obstetrical clinics, during a breech delivery, to have an attendant call out the half minutes so that the operator may thereby be stimulated to more and more heroic efforts as the lethal moment, established by the time tradition for that particular clinic, approaches. That the importance of asphyxia as a cause of death in breech deliveries has been exaggerated with the resulting development of unsound philosophy and practice, is shown by a convincing literature that finds almost no reflection in textbooks on obstetrics, or in routine clinical practice. This evidence is found to arise from clinical, pathological, and physiological observations.

LITERATURE

A. Experimental and pathological evidence of injuries from breech delivery in the newborn. In 1874, Duncan (6) performed experiments on the tensile strength of a fresh adult fetus. He found that the vertebral column yielded with traction of 105 pounds, and that decapitation occurred with 120 pounds. He found that the cervical vertebræ invariably gave way, that one leg was stronger than the neck, and that the soft parts resisted longer than the skeleton.

In 1875, Ruge (18) reported 8 cases of ruptured cervical spine in a series of 64 dead babies delivered by the breech. He noted that obstetrical vertebral fractures consist in the detachment of the epiphyses along the normal demarcation line.

In 1892, Spencer (19) reported a series of 130 autopsies on fresh, mostly stillborn, fetuses in a study of visceral hæmorrhages. He found hæmorrhage somewhere within the spinal canal in 30 cases. He concluded that spinal hæmorrhage was greatly favored by presentation of the lower extremity.

[1] From the Department of Obstetrics and Gynecology under the direction of Professor William E. Studdiford, and from the Department of Pathology under the direction of Associate Professor W. C. Johnson, College of Physicians and Surgeons, Columbia University.

In 1907, Hofbauer (9) reported the cervical spine most often injured, and the sixth cervical vertebra most frequently fractured in breech deliveries.

Stoltzenberg's (20) classic description of vertebral birth injuries appeared in 1911. It was abstracted by Kooy as follows: "She found 9 vertebral fractures in 75 autopsies on babies dead from 'Asphyxia.' Eight of these were in breech deliveries. The mechanism of the rupture was the following: First of all, the lateral capsule ligaments were torn, then followed the adjacent part of the ligaments of the neural arch (which are very tender in the newborn); finally, the cartilaginous part of the vertebræ themselves. The author confirmed this conception by experiments on extraction of the bodies of newborn children with a traction of a certain power. She obtained the same kind of rupture, the extent of which was proportional to the degree of deviation from the longitudinal axis in a lateral direction to the power of traction. It was evident that especially cases of the aftercoming head with difficult development of the arms and shoulders caused the spinal lesion in question, for in these cases, traction at the column is combined with deviation from the longitudinal axis, and it is also easily understood that it is especially the cervical column that is most apt to rupture for the angle between the axis of traction and the child's longitudinal axis is situated there."

In 1912, Meyer and Hauch (7) found ruptures of the cranial dura in 11, or 23 per cent, of 47 breech delivery deaths. Five of these were thought to have caused the death of the baby.

Von Reuss (17), in 1914, gave a masterly account of birth injuries to the skull, vertebral column, and central nervous system. He reviewed the literature to date. Some of his observations were as follows: "The hæmorrhages affecting the central nervous system, which are important in the pathology of the newborn, are almost entirely of traumatic origin. The rupture of vessels which give rise to hæmorrhage are, so far as they concern larger vessels, the direct consequence of birth injuries. Smaller extravasations of blood owe their origin chiefly to congestion caused by labor and, therefore, are indirectly attributable to action of forces during the birth process. Congestion, for its part, exercises considerable influence on the intensity of hæmorrhage caused by direct trauma, so the clinical differentiation between traumatic and congestive hæmorrhage is not possible." In speaking of injuries within the spinal canal, von Reuss said: "Birth trauma is the most important etiological factor for hæmorrhage in the spinal canal, just as it is for cerebral hæmorrhage; hæmorrhages within the vertebral canal and within the canal itself occur practically entirely after forcible extraction from a breech presentation. They may or may not be combined with injuries of the vertebral column. Ruptures within the region of the vertebral column which occur chiefly in the cervical region, almost always cause death a short time after birth, as they lead to intraspinal extravasation of blood into the vertebral canal which compresses not only the cervical portion of the cord, but may also reach the medulla oblongata and posterior fossa of the skull. Extraction of the child may, however, cause rupture of the vessels, extravasation of blood in the cord and its membranes without there being injury of the vertebral column."

Warwick (21), in 1921, found 3 cases of fractured cervical vertebræ occurring in version and breech deliveries in a series of 130 autopsies.

Brown (2), in 1922, reported 153 autopsies on the newborn with special reference to the cause of death. In concluding he said in part: "If we take 3 per cent as the normal frequency of breech deliveries, it is found that the latter is ten times as likely to give rise to cerebral hæmorrhage as is delivery by the vertex." He also noted that hæmorrhage in the adrenals was twenty-two times more common in breech than in vertex deliveries.

Capon (4), in 1922, in a series of 80 neonatal deaths and stillbirths studied at autopsy, found that 4 out of the 10 breech babies in the series showed spinal injury; 3 of them showed separation of the epiphyses from the body of the sixth and seventh cervical and third thoracic vertebræ, respectively.

TABLE I.—BREACH DELIVERIES RESULTING IN DEATH OF A VIABLE BABY AUTOPSY SHOWING ONE OR MORE FRACTURED VERTEBRÆ

History No. Series No.	Age Race Para	Important obstetrical conditions and procedures	Important autopsy findings	Clinical notes A. Cervix D. Cord. B. Arms E. Anæsthesia. C. Head F. Time of delivery.
44742 1	20 Black 1 normal full term delivery	Breech presentation Stillbirth	Weight 4500 gms. Length 53 cms. Head 35.5 cms. Transverse fracture of sixth cervical vertebra. Complete laceration of spinal cord. Moderate fluid hæmorrhage at base of brain	In the breech extraction both arms became extended and were delivered with difficulty posteriorly. Time of delivery from navel to mouth 3¼ minutes. Total time of delivery 10 minutes. Cause of death: trauma.
1853 2	25 Italian Para-O	Dry labor Frank breech Stillbirth	Weight 3700 gms. Length 44 cms. Transverse fracture sixth cervical vertebra. Brain is congested and shows diffuse hæmorrhage and œdema	Frank breech presented at vulva. Feet were then brought down. No further details save that there was difficulty in the delivery of the head. Cause of death: trauma.
2188 3	22 Jewess Para-O	Dry labor Frank breech Asphyxia pallida Death at birth	Weight 4000 gms. Length 53 cms. Head 35.5 cms. Transverse fracture of fourth cervical vertebra. No laceration of spinal cord. Moderate extradural hæmorrhage at base	No details save that the head was delivered with difficulty. Baby's heart continued 1 hour after birth. Cause of death: trauma.
714 4	31 White 1 stillbirth Cause not stated	Frank breech Stillbirth	Weight 3500 gms. Length 53 cms. Head 35.5 cms. Marked extradural hæmorrhage in cervical region of spinal cord. Extradural hæmorrhage at base of brain. Transverse fractures of two cervical vertebræ. Marked hæmorrhage into muscles and fascia anterior to cervical vertebræ	The first arm was delivered anteriorly, the second posteriorly. No further details of the technique save that difficulty was encountered with the aftercoming head. Total time of delivery 10 minutes. Cause of death: trauma.
42844 5	26 White Para-O	Dry labor Frank breech Dilatation of cervix-bag Craniotomy Stillbirth	Weight 7 lbs. 12 ozs. Length 52 cms. Head 33 cms. Transverse fracture of sixth cervical vertebra. Fluid blood in spinal canal. Hæmorrhage in prevertebral fascia from third cervical to first dorsal vertebra	Delivery described as easy up to the head when chin became anterior and the head extended. Finally craniotomy was done. Time of delivery 17 minutes. Cause of death: trauma.
42948 6	40 Black Para-O	Male type pelvis Frank breech Asphyxia pallida Death at birth	Weight 3400 gms. Length 52.5 cms. Head 35.5 cms. Transverse fracture of sixth cervical vertebra. Moderate extradural hæmorrhage in dorsal region of cord, very little subdural hæmorrhage. Spinal cord not lacerated. Slight subdural hæmorrhage at base. Marked hæmorrhage into anterior cervical tissues, behind œsophagus to pharynx and behind parietal pleura at both apices. There is also hæmorrhage into tissues of left axilla	Cervix fully dilated. Arms became extended and were delivered posteriorly. Extraction of head not difficult. Total time of delivery 6 minutes, navel to mouth 5 minutes; baby gasped during delivery. Heart continued for ½ hour. Cause of death: trauma.
43519 7	26 Black 6 normal deliveries 1 Cæsarean	Frank breech Asphyxia pallida Death of baby	Weight 3300 gms. Length 48 cms. Head 34 cms. Transverse fracture of sixth cervical vertebra. No laceration of cord but marked extra- and subdural hæmorrhage. Considerable subdural hæmorrhage at base of brain. Clotted hæmorrhage in both hemispheres of cerebellum. Moderate laceration of cerebellar tissue. There are scattered hæmorrhages in tentorium cerebelli. Lungs showed diffuse pneumonia	Cervix fully dilated. Complete ether anæsthesia. Feet brought into vagina. Both arms delivered posteriorly. No difficulties in delivery mentioned. Time of entire delivery 5 minutes. Baby lived 3 days. Cause of death: trauma.

Eardley Holland (10), in 1922, reported an investigation into the factors which determined death in 300 viable fetuses. Concerning injuries and their causes sustained by the baby in breech deliveries, he said: "I will state at once the remarkable fact that tears of the tentorium cerebelli and cerebral hæmorrhage are almost constantly found in dead fetuses delivered by the breech; this throws a flood of light on the cause of fetal death in breech labor and indicates precisely the obstetrical faults in its management. The fact that 14 out of 16 fetuses which died as the result of breech delivery showed, postmortem, signs of excessive cranial stress is of great importance."

B. Clinical and pathological evidence in older children of birth injuries from breech deliveries. McNutt (14), in 1885, reported the autopsy findings in a child suffering from spastic paraplegia or Little's disease that died of pneumonia at 2½ years. The child had had a difficult breech delivery requiring forceps on the aftercoming head. It had had convulsions during the first 9 days of life. A splendid gross and microscopic study of the central nervous system was detailed by Amidon and Welsh. McNutt reported also a child that died on the eighth day following difficult breech delivery. At autopsy, cerebral and spinal cord hæmorrhage was found. Thus McNutt and her collaborators supplied the

TABLE II.—VERSION AND BREECH DELIVERIES RESULTING IN DEATH OF A VIABLE BABY AUTOPSY SHOWING ONE OR MORE FRACTURED VERTEBRÆ

History No. Series No.	Age Race Para	Important obstetrical conditions and procedures	Important autopsy findings	Clinical notes A. Cervix B. Arms C. Head D. Cord. E. Anæsthesia. F. Time of delivery.
41[illegible] [illegible]	[illegible] Black 3 normal deliveries	Placenta prævia Dilatation of cervix-bag Version and breech Stillbirth	Weight 2550 gms. Length 40 cms. Transverse fracture through body of sixth cervical vertebra at junction of cartilage between fifth and sixth vertebræ. Spinal cord lacerated and protruding through opening. Marked extra- and subdural hæmorrhage in cervical spinal cord. Moderate diffuse hæmorrhage at base of brain. Marked hæmorrhage into anterior cervical tissues	Marked difficulty was encountered in the delivery of the aftercoming head. The difficulty was attributed to incomplete dilatation of the cervix. A snap was heard while efforts were being made to deliver the head. Total time of delivery 5 minutes. Cause of death: trauma.
[illegible] 0	27 Black Para-0	Flat pelvis Dilatation of cervix High forceps Version and breech Stillbirth	Weight 3700 gms. Length 53 cms. Transverse fracture through body of fifth cervical vertebra. No lacerations of spinal cord. Extra- and subdural hæmorrhage of cervical cord. Slight subdural hæmorrhage at base of brain Separation of epiphyses of femur on right side	Cervix fully dilated. One leg only brought down; there was marked difficulty in bringing the half breech through the pelvis. No details of delivery of arms and head but described as not difficult. Cause of death: trauma.
42760 [illegible]	28 White 1 instrumental Died at birth	Flat pelvis Version and breech Dilatation of cervix—manual Asphyxia pallida Death at birth	Weight 3700 gms. Length 53 cms. Transverse fracture involving disc between fifth and sixth cervical vertebræ. Spinal cord lacerated. Marked subdural hæmorrhage in cervical region. Slight subdural hæmorrhage at base of brain. Marked hæmorrhage into anterior cervical tissues	Cervix dilated manually. Umbilical cord twice around neck and once around body. No difficulty described in delivery but details are lacking. Total time of delivery 4 minutes Heart continued for several minutes and baby gasped twice. Cause of death: trauma.
[illegible] [illegible]	27 Black 3 normal deliveries 1 stillbirth from impacted shoulders	Dry prolonged labor Dilatation of cervix-bag Generally contracted pelvis Version and breech Asphysix pallida Death at birth	Weight 3300 gms. Length 49 cms. Cranial bones very hard. Transverse fracture of sixth cervical vertebra at junction of cartilage between fifth and sixth vertebræ. Spinal cord not lacerated. Slight diffuse hæmorrhage at base of brain. Hæmorrhage into anterior cervical tissues	Marked difficulty with delivery of shoulders. Both finally delivered posteriorly. No difficulty in delivery of head. Baby's heart continued for 20 minutes. Cause of death: trauma.
480 [illegible]	2 normal deliveries	Transverse presentation Version and breech Stillbirth	Weight 3400 gms. Length 51 cms. Transverse fracture of sixth cervical vertebra. No lacerations of cord. Slight subdural hæmorrhage in cervical region. Marked hæmorrhage into anterior cervical tissues Brain described as relatively normal	Cervix completely dilated. Both arms became extended, the posterior one was delivered first. Time from birth of navel to delivery of head was 7 minutes. Cause of death: trauma.
[illegible] [illegible] See Figure [illegible]	32 White 2 normal deliveries	Placenta prævia Dilatation of cervix-bag Version and breech Stillbirth	Weight 3500 gms. Length 36 cms. Transverse fracture of third thoracic vertebra. Laceration of spinal cord is complete. Marked hæmorrhage into tissues about site of fracture. Brain not described	Cervix incompletely dilated. Marked difficulty in delivery of head, thought to be due to cervix. Total time of delivery 5 minutes. Cause of death: trauma.
1397 [illegible]	[illegible] Black 2 normal deliveries 1 instrumental	Old laceration of cervix. Cicatrix of cervix. Generally contracted flat pelvis Version and breech Stillbirth	Weight 3800 gms. Length 53 cms. Head 36.5 cms. Transverse fracture of sixth cervical vertebra. Marked hæmorrhage into adjacent cervical tissues. Brain shows congestion and some blood on surface of the hemispheres	Marked difficulty in delivery of aftercoming head. No details. Cause of death: trauma.

pathological evidence necessary to complete the contention of Little (13) based upon clinical observations. She showed the relationship between cerebral and spinal hæmorrhage at birth and Little's disease of later life, and noted that such hæmorrhage was particularly common as the result of breech delivery.

Beevor (1), in 1902, reported a baby born by difficult breech extraction that showed paralysis of the right arm and both legs. It died at 15 weeks. At autopsy, fracture-dislocation of the third cervical vertebra was found with complete destruction of the spinal cord below.

Kooy (11), in 1920, reported a case of Little's disease that died in its ninth year. It had been delivered by version and breech extraction. Rupture of the low thoracic spinal cord was found at autopsy. He gave in admirable detail the clinical and pathological findings of this case, as well as an excellent résumé of the literature.

Burr (3) reported, in 1920, 2 cases of flaccid paralysis following breech delivery. One child

TABLE III.—VERSION AND BREECH DELIVERIES RESULTING IN DEATH OF A VIABLE BABY

History No. Series No.	Age Race Para	Important obstetrical conditions and procedures	Important autopsy findings	Clinical notes A. Cervix D. Cord. B. Arms E. Anæsthesia. C. Head F. Time of delivery.
42870 15	White Para-O	Prolonged labor Transverse presentation Version and breech Stillbirth	Weight 2900 gms. Length 52 cms. Head 33.5 cms. Skull and brain described as relatively normal. No fracture of spine. Spinal cord not examined	Cervix 3 fingers dilated when membranes ruptured and elbow presented. Cervix then dilated manually. Delivery described as not difficult. No details of treatment of arms. Time of delivery: foot 2:58, breech 3:00, navel 3:03, shoulders 3:04, mouth and head 3:05. Cause of death: asphyxia-trauma.
43490 16	32 Black Para-O	Male pelvis funnel Dry labor Dilatation of cervix-bag High forceps Version and breech Craniotomy Stillbirth	Weight 7 lbs. 4 ozs. Length 52 cms. No autopsy	Beginning contraction ring. No progress with forceps. Marked difficulty in delivering arms and head. Craniotomy finally done because fetal heart had ceased. Cause of death: asphyxia-trauma.
43531 17	24 Black 1 instrumental Stillbirth	Prolapsed cord Version and breech Stillbirth	Weight 4200 gms. Length 54 cms. Head 35 cms. Brain described as relatively normal. No fractures of vertebræ. No laceration of cord. Moderate extradural hæmorrhage in cervical region	Pulsating prolapsed cord found with cervix fully dilated. Shoulders delivered, the first anteriorly, the second posteriorly. The head became extended and was delivered with difficulty. Time of delivery: foot 4:11, breech 4:17, navel 4:18, shoulders 4:20, mouth 4:24, head 4:25. Cause of death: asphyxia-trauma.
2087 18	39 White Para-O	Prolonged labor Uterine inertia High forceps Version and breech Craniotomy Stillbirth	Weight 3650 gms. Length 53 cms. Spine and cord severed by craniotomy	No advance with axis traction forceps. Cervix dilatable. Extraction described as easy up to head. Details of difficulty with head not described. Cord finally ceased pulsating so that craniotomy was done. Cause of death: asphyxia-trauma.
1060 19	26 White Para-O	Flat pelvis Prolapsed cord Version and breech Stillbirth	Weight 3150 gms. Length 52 cms. Brains and spine described as relatively normal	Version because of partial prolapse of cord with heart under 100. Extraction easy up to head. Difficulty with head ascribed to pelvis. Total time of extraction about 10 minutes. Cause of death: asphyxia-trauma.
43053 20	35 White Para-O	Pelvis obliquely contracted Toxæmia of pregnancy Induction of labor-bag Version and breech Asphyxia pallida Death at birth	Weight 2950 gms. Length 40 cms. Slight diffuse hæmorrhage over brain with moderate œdema of pia arachnoid. No fractures of spine.	Extraction described as difficult because of small pelvis. Difficulty with aftercoming head. Heart continued for several minutes. Cause of death: asphyxia-trauma.
45096 21	42 White 2 normal deliveries 2 instrumental deliveries	Mitral stenosis Prolapsed cord Version and breech Asphyxia pallida Death at birth	Weight 5 lbs. 11 ozs. Length 49 cms. No autopsy	Version was done and cord replaced through a cervix well thinned out but not completely dilated. Baby's feet brought into vagina, fetal heart normal. In 4 hours patient pushed thighs of baby to vulva. Extraction was begun under "light anæsthesia." Anterior arm became extended but was delivered easily. Difficulty with aftercoming head thought to be due to cervix. Baby's heart continued for one hour. Cause of death: asphyxia-trauma.
2300 22	40 White Grav.-XII Several Normal deliveries; 2 instrumental	Toxæmia of pregnancy High forceps Version and breech Stillbirth	Weight 4058 gms. Length 51.5 cms. No autopsy	High forceps attempted—no advance. Version in tonic uterus. Breech extraction described as easy up to head. Details of arms not described. Cord not pulsating when breech was delivered. Details of difficulty with head not described. Cause of death: asphyxia-trauma.
43381 23	20 White 1 full term normal	High forceps Version and breech Craniotomy Stillbirth	Weight 8 lbs. 14 ozs. Length 54 cms.	Six hour second stage—no progress. Head extended. High forceps attempted—no advance. No details of delivery save that aftercoming head could not be delivered. Craniotomy finally done. Cause of death: asphyxia-trauma.
1776 24	35 White Para-O	Male pelvis Placenta prævia Hæmorrhage High forceps Version and breech Stillbirth	Weight 9 lbs. 10 ozs. No autopsy	Delivery of the aftercoming head became difficult at the pelvic outlet. Considerable hæmorrhage intrapartum and postpartum. Cause of death: asphyxia.

TABLE III.—VERSION AND BREECH DELIVERIES RESULTING IN DEATH OF A VIABLE BABY—CONTINUED

History No. Series No.	Age Race Para	Important obstetrical conditions and procedures	Important autopsy findings	Clinical notes A. Cervix B. Arms C. Head D. Cord. E. Anæsthesia. F. Time of delivery.
711 25	30 White Para-0	Flat pelvis Toxæmia of pregnancy Medium forceps Version and breech Asphyxia pallida Death of baby	No autopsy	No advance of head with traction on forceps. Easy version and breech. No difficulties encountered. Baby had convulsions and bleeding from ear. Died on third day. Cause of death: trauma.

died at 4½ months and showed at autopsy a level of hæmorrhage to the fourth cervical vertebra with destruction of the cord to the first dorsal. The second baby died at 3 months. No autopsy was permitted.

In 1923, Crothers (5) reported 5 cases of paraplegia in childhood, the result of injury to the spinal cord in breech extraction. He gave a review of the literature and an adequate discussion of the obstetrical, pathological and physiological factors involved in the causation of such injuries.

Thus the literature affords abundant evidence of the immediate and late manifestations of the casualties of breech deliveries.

CLINICAL AND PATHOLOGICAL STUDY OF THIRTY-EIGHT CASES OF INJURY AND DEATH FROM BREECH DELIVERY

For the past 3 years, 76 per cent of all antenatal, natal, and neonatal deaths at the Sloane Hospital for Women have been studied at autopsy. It was noted that deaths in breech deliveries often occurred in large well-developed babies, and that many showed fractured vertebræ at autopsy. Many of the earlier autopsies were unsatisfactory, because an adequate routine technique was not followed, so that the occurrence of tentorial lacerations was not noted, nor were the various types of cerebral and spinal cord hæmorrhages described adequately in some cases. Latterly, through the lessons of experience and study of the literature, a complete autopsy technique has been adopted.[1]

From March, 1920, to September, 1922, in 142 viable babies in primary breech deliveries, natal and neonatal death occurred in 18, or 12 per cent. The incidence of breech presentation was 3 per cent. In 87 viable babies delivered by version and breech during the same period, natal or neonatal death occurred in 18, or 26 per cent. Version and extraction in this series was never elective, but was indicated by placenta prævia, prolapsed cord, malpresentation, or an abnormal pelvis. A clinical and pathological study of these natal or neonatal deaths is tabulated.

CLINICAL AND PATHOLOGICAL SUMMARY

1. In 142 viable primary breech deliveries, natal or neonatal death occurred in 18, or 12 per cent. The incidence of breech presentation was 3 per cent.

2. In 87 viable version and breech deliveries, natal or neonatal death occurred in 18, or 26 per cent.

3. Spinal cord hæmorrhage was noted in 17, or 47 per cent, of the 36 cases; fractured vertebræ were found in 14, or 38 per cent.

4. Intracranial hæmorrhage was present in 44 per cent. However, it was considerable in only 25 per cent.

5. Clinical difficulty with delivery of the head was noted in 57 per cent of the cases; difficulty with arms and shoulders in 25 per cent; and difficulty from an incompletely dilated cervix in 11 per cent of the cases.

[1]Autopsy technique. Mid line incision from chin to pubis passing to left of navel. All organs of neck, thorax and abdomen are examined *in situ*, removed and weighed and examined grossly and microscopically. All vertebræ are exposed anteriorly and examined for luxation and fracture. A posterior mid line incision is then made from occiput to sacrum. Starting at the sacrum, the laminæ are cut with bone forceps and the spinal dura exposed throughout its length. The complete cord is then removed inclosed in the dura and examined for hæmorrhage and injury. The scalp is then incised approximately in the line of the coronal suture and the scalp reflected anteriorly and posteriorly over the entire skull. The anterior fontanel is punctured with a knife at its lateral margin so that bone scissors may be inserted. The bone and dura are divided on both sides parallel to the longitudinal sinus, but at a safe distance from it, posteriorly as far as the lambdoid suture and anteriorly as far as possible. The flap is then continued posteriorly along the line of the lambdoid suture and squamous suture and as low as possible on the frontal and parietal bones. Before removal of the brain, the hemispheres are gently retracted and the falx and tentorium examined for tears and hæmorrhages.

TABLE IV.—BREECH DELIVERIES RESULTING IN DEATH OF A VIABLE BABY

History No. Series No.	Age Race Para	Important obstetrical conditions and procedures	Important autopsy findings	Clinical notes A. Cervix B. Arms C. Head D. Cord. E. Anæsthesia. F. Time of delivery.
45332 20	40 White 2 normal deliveries	Breech presentation Prolapsed cord Asphyxia pallida Death at birth	Weight 8 lbs. 5 ozs. Length 54 cms. No autopsy	Prolapsed cord replaced through cervix dilated to 3 fingers. Feet allowed to remain in cervix 1 hour. Fetal heart satisfactory just before delivery. No difficulties described in the delivery. Total time of delivery 4 minutes. Baby's heart continued beating slowly for 40 minutes. Cause of death: asphyxia-trauma.
42683 27	33 White Para-O	Toxæmia of pregnancy Induction of labor-bag Breech extraction Forceps on aftercoming head Occiput posterior persistent Asphyxia pallida Death at birth	Weight 3200 gms. Length 50 cms. Head 37 cms. Spine showed no fractures. Brain described as relatively normal Spinal cord not examined	Vertex presented before induction with No. 2 Bag No. 3 Bag used next. When bag came through Frank breech was reduced by bringing down 1 leg. Delivery described as easy up to head which became occipitoposterior and could not be delivered. Forceps applied and head delivered quickly as occipitoposterior. Heart continued beating for 1 hour. Cause of death: trauma.
44670 28	White 1 instrumental delivery Baby well	Dry labor Frank breech Stillbirth	Weight 8 lbs. Length 52 cms. No autopsy	Fetal heart could not be heard when breech presented at vulva. Delivery described as easy. No details. Time of delivery 4 minutes. Cause of death: asphyxia.
448 29	37 White 3 normal deliveries	Toxæmia of pregnancy Twin pregnancy A. Vertex B. Breech Stillbirth	Weight 1950 gms. Length 29 cms. Brain described as relatively normal No vertebral fractures Spinal cord not described	Second baby presented by breech. Cord was not pulsating when navel was born. No details of delivery. Time of delivery 5 minutes. Cause of death: asphyxia trauma.
748 30	26 White Para-O	Twin pregnancy A. Breech, prolapsed cord, dilatation of cervix Asphyxia pallida Death of baby B. Vertex, version and breech	Weight 6 lbs. 6 ozs. Length 49 cms. Spine and brain described as relatively normal	Cervix dilated manually from 2 fingers to full dilatation because of prolapsed cord. Baby's heart beating at birth. No details of technique of delivery. Time of extraction 1½ minutes. Second stage of labor 50 minutes. Cause of death: asphyxia-trauma.
43806 31	40 White Para-O	Grave's disease Premature labor Dry labor Breech presentation Stillbirth	Weight 2060 gms. Length 44.5 cms. Head-occipital frontal 31.5 cms. No caput but small cephalhæmatomata over occipitals and parietals. Moderate amount of fluid blood over hemispheres and at base. Source not found. No hæmorrhage into brain or dura. Spine showed no lesions	Patient pushed buttocks to vulva so that cervix was thought to be well dilated. There was moderate difficulty with the head but it was thought that no undue traction was exerted. Time of delivery 6 minutes. Cause of death: trauma.
43845 32	White Para-O	Generally contracted pelvis Dry labor Frank breech Dilatation of cervix-bag Uterine inertia Asphyxia pallida Death at birth	Weight 3550 gms. Length 51 cms. Occipital frontal 36 cms. No fractures of spine. Moderate extra- and subdural hæmorrhage about cord at second and third cervical vertebræ. No laceration of cord. Small diffuse subdural hæmorrhages over hemispheres. Several small hæmorrhages in dura. Middle ears normal	When a No. 3 bag came through cervix the frank breech was reduced by bringing down a leg. Delivery described at every stage as difficult. First arm delivered anteriorly and the second posterioriy. Time of delivery 9½ minutes. Foot :28, breech :34, navel :35, shoulders :36, mouth :37, head :37.5. Baby's heart continued for 10 minutes. Cause of death: trauma.
43157 33	27 Black Para-O	Dry labor Dilatation of cervix-bag Breech presentation Laceration of cervix Asphyxia pallida Death at birth	Weight 3100 gms. Length 50 cms. Spine normal. Cord not described. Moderate diffuse subdural hæmorrhage about brain. Scattered small hæmorrhages in dura. Small amount of subarachnoid hæmorrhage. No hæmorrhages in brain substance	Cervix incompletely dilated and torn at delivery. Head became extended and was delivered with difficulty after hard pulling. Something was heard to snap during its delivery. Total time of delivery 9 minutes. Time from navel to mouth 3 minutes. Baby gasped a few times and heart continued for a short time. Cause of death: trauma.
43875 34	26 1 normal delivery at term	Breech presentation Craniotomy Stillbirth	Weight 9 lbs. Length 57 cms. No autopsy	Cervic fully dilated. First arm delivered anterior, second posterior. There was difficulty in the delivery of arms and head. Cord stopped pulsating so craniotomy was done. Time of delivery: foot :14, breech :20, navel :21, shoulders :30, mouth :37, head :37. Total 23 minutes. Cause of death: asphyxia-trauma.

TABLE IV.—BREECH DELIVERIES RESULTING IN DEATH OF A VIABLE BABY—CONTINUED

History No. Series No.	Age Race Para	Important obstetrical conditions and procedures	Important autopsy findings	Clinical notes A. Cervix B. Arms C. Head D. Cord E. Anæsthesia F. Time of Delivery.
43643 35	39 White Para-VIII 3 normal deliveries	Breech presentation Prolapsed cord Stillbirth	Weight 8 lbs. Length 56 cms. No autopsy	Cervix fully dilated. Knee in vagina with loop of pulsating cord. Both shoulders delivered posteriorly. Head delivered with relative ease. Time of delivery, foot :40, breech :42, navel :43, shoulders :43, mouth :45, head :45½. Total 5.5 minutes. Cause of death: asphyxia-trauma.
44021 36	24 White Para-O	Dry labor Prolonged labor Breech presentation Frank breech Asphyxia pallida Death at birth	Weight 3250 gms. Length 50 cms. Head 35½ cms. No fractures of spine but extra- and subdural hæmorrhage in the cervical region. Moderate diffuse fluid hæmorrhage over hemispheres. No hæmorrhage into brain or into ventricles. Middle ears normal	Dry prolonged labor first stage 34 hours, second stage 2½ hours. When cervix was fully dilated frank breech was reduced by bringing both feet into vagina. Head became extended and was delivered with difficulty. Baby's heart beating at birth. Cause of death: trauma.

6. Abnormality of cord or placenta was noted in 28 per cent of the 36 cases.

7. Trauma alone was the probable cause of death in 56 per cent of the 36 cases of natal or neonatal death; asphyxia alone, the probable cause in 5 per cent; trauma and asphyxia may have both been causative factors in 39 per cent.

8. Time of delivery from foot to head was noted in 17 cases; the average was 7 minutes.

Time of delivery from navel to mouth was noted in 8 cases; the average was 4 minutes.

9. A dilating bag had been placed in the cervix in 25 per cent of the cases; abnormal pelvis was noted in 35 per cent of the cases; 50 per cent of the mothers were primiparæ.

DETAILS AND DISCUSSION

Lacerations of the spinal cord. The spinal cord was completely ruptured at site of fracture in two cases (1 and 13), and partially ruptured in two more (8 and 10).

Hæmorrhages involving the spinal canal. Hæmorrhage was found in the spinal canal in 17 of the 36, or in 47 per cent. The 14 cases with fractured vertebræ showed extradural and subdural hæmorrhages in the affected region of the cord. Three additional cases (17, 32, and 36) showed moderate hæmorrhages in the cervical region of the cord.

Fractured vertebræ. Fourteen, or 38 per cent, of the 36 natal or neonatal deaths showed fractured vertebræ (1 and 14). Seven were primary breech and 7 were version and breech deliveries. One additional baby died at the age of 1 month (Case 37) with signs of severe cervical cord injury that probably was accompanied by vertebral fracture.

The typical lesion, a transverse separation of the upper epiphyseal plate (cartilage) of the sixth cervical vertebra, is exemplified by 10 of the 14 cases. The fourth and fifth cervical vertebræ were each fractured once. In one case (Case 13), the third thoracic vertebra showed a transverse fracture. Thus, 13 cases showed cervical fractures and one, a thoracic.

Of the 14 cases of vertebral fracture there were 9 dead-births (Cases 1, 2, 4, 5, 8, 9, 12, 13, 14), 4 deaths-at-birth (Cases 3, 6, 10, 11), and 1 neonatal death (Case 7) in which the baby survived for 3 days. Five of these babies survived delivery for a short period in a condition of so-called "asphyxia pallida."

The mechanism of these fractures was a posterior or lateral flexion of the spine combined with traction, or excessive flexion, or traction, alone. Clinical study of the case histories showed that all but two of the cases were complicated by extended arms, or difficult delivery of the head. Duplication of these complications on a manikin verified the mechanical etiology mentioned.

Intracranial hæmorrhage. Cerebral hæmorrhage was marked in only one case (Case 7). This brain showed a clotted hæmorrhage in both hemispheres of the cerebellum with moderate laceration of the cerebellar tissue. There was considerable fluid hæmorrhage at the base and scattered hæmorrhages into the tentorium.

Moderate cerebral hæmorrhage was present in 8 cases (Cases 1, 2, 3, 4, 8, 31, 33, 36) and slight hæmorrhages in 7 more (Cases 6, 9,

TABLE V.—VERSION AND BREECH DELIVERIES FOLLOWING WHICH THE BABY SHOWED SIGNS SUGGESTING SPINAL CORD INJURY

History No. Series No.	Age Race Para	Important obstetrical conditions and procedures	Important autopsy findings	Clinical Notes A. Cervix D. Cord B. Arms E. Anæsthesia C. Head F. Time of Delivery.
2257 37	28 Black 4 normal deliveries	Face presentation R. M. A. Version and breech Asphyxia pallida	Weight at birth 6 lbs. 1 oz. Baby died at 1 month of age. Autopsy refused. Bilateral flaccid paralysis lower limbs	Cervix fully dilated. Delivery of aftercoming head described as difficult. Cause of death: trauma.
42691 38	21 Black Para-O	Generally contracted flat pelvis Chronic cardiac valvular disease Dilatation of cervix-bag Version and breech Asphyxia pallida	Weight at birth 4 lbs. 1 oz. Length 46 cms. Left lower abdominal paralysis and hernia Child apparently well at 1 year	Delivery of arms difficult because of nuchal hitch. Left elbow dislocated. Coccyx broken before head could be delivered.

10, 11, 14, 20, 32). No intracerebral, nor intraventricular hæmorrhage was found. The hæmorrhage was diffuse, fluid, and most marked at the base of the brain. To recapitulate, marked or moderate hæmorrhage was found in 25 per cent of the cases and some hæmorrhage in 44 per cent. The comparatively few cases of important intracranial hæmorrhage is surprising in view of the other evidences of birth injuries found. Explanation of this may be that these babies did not live long enough for any considerable hæmorrhage to accumulate. Thus, of the entire 36 cases, 22 were dead-births, 13 were deaths-at-birth, and 1 a neonatal death. Moreover, the baby that lived longest, namely 3 days (Case 7), showed the largest cerebral hæmorrhage.

Of the 16 cases of intracranial hæmorrhage, 9 (Cases 3, 6, 7, 10, 11, 20, 32, 33, 36) survived delivery for a short period in a condition of so-called "asphyxia pallida."

Dead-births: Asphyxia or trauma the cause of death? The term dead-birth is used because it avoids the ambiguity of the term stillbirth, which may be used to signify (1) a baby born with active heart that never cries, (2) a baby born with heart not beating.

Of 22 dead-born babies in the 36 breech delivery deaths, trauma alone was the cause of death in 10, or 45 per cent (Cases 1, 2, 4, 5, 8, 9, 12, 13, 14, 31); asphyxia alone the probable cause in only 2, or 10 per cent (Cases 24 and 28); and asphyxia and trauma the possibly concomitant causes in 10, or 45 per cent, of the cases (Cases 15, 17, 18, 19, 22, 23, 29, 34, 35). In 5 of these cases, craniotomy was done; they are listed under death from asphyxia trauma, because, theoretically, some of these babies may have died from asphyxia before craniotomy. Study of these cases (Cases 5, 16, 18, 23, 34) shows, however, that marked obstetrical difficulties arose, due, presumably, to antecedent errors of judgment or art. Having found trauma unexpectedly present in many cases, when no obstetrical difficulties were noted, it seems logical to consider trauma, in general, a more important factor for fetal death than asphyxia in cases requiring craniotomy.

Death-at-birth: Asphyxia or trauma the cause of death? Death at birth is the term applied to babies that fail to maintain respiration. They usually die within an hour. Of this group of 13 (Cases 3, 6, 7, 10, 11, 20, 21, 26, 27, 30, 32, 33, 36), all showed asphyxia pallida, yet clinical and pathological study revealed trauma alone the probable cause of death in 9. Trauma and asphyxia were possibly concomitant causes in 4; whereas, in not a single case was there strong evidence that asphyxia alone was the cause of death. Moreover, 8 of these babies showed intracranial and intraspinal hæmorrhage, and 5 of the 8 had broken necks. Of the remaining 5, autopsy was refused in two.

Neonatal deaths and deaths in infancy: Asphyxia or trauma the cause of death? Case 7 survived difficult delivery for 3 days with a broken neck and large intraspinal, intra-

Fig. 1. The typical lesion—separation of the upper epiphyseal plate of the sixth cervical vertebra with intraspinal hæmorrhage.

Fig. 2. Tear in tentorium in baby delivered by breech. This baby had also intracranial hæmorrhage, intraspinal hæmorrhage, and a broken neck.

cranial, and cerebellar hæmorrhage in a condition of so-called "asphyxia pallida." Trauma and severe birth injury were obviously the cause of death. Case 37 survived difficult delivery for 1 month, having shown clinically so-called "asphyxia pallida" for a considerable period after birth, and after that a bilateral flaccid paralysis of the lower limbs. Trauma and birth injury were obviously the cause of disability and death in this case.

Clinical and pathological study of the dead births, deaths at birth, and neonatal deaths, resulting from breech deliveries, showed that trauma was more important in the causation of fetal death than asphyxia.

Placental and umbilical cord abnormalities. There were 3 cases of placenta prævia (Cases 8, 13, 24). It is evident that in partial or complete placenta prævia, and premature separation of the placenta, from any cause, there is great danger of fetal asphyxia. This was illustrated in Case 24. However, in the other 2 cases of placenta prævia, the babies showed fractured vertebræ, caused by difficulty in delivery of the aftercoming head; a difficulty attributed, in each case, to an incompletely dilated cervix. The delivery of each of these cases required only 5 minutes.

Prolapsed cord occurred in 6 of the 36 cases (Cases 17, 19, 21, 26, 30, 35). The cord was around the neck in one (Case 10). Yet fetal deaths from asphyxia alone could not be attributed to cord complications in a single instance, for in every case the clinical history showed that: (1) the cord was pulsating at the time of delivery; (2) the baby's heart was beating at birth. Moreover, 3 of the cases (Cases 17, 19, 21) were complicated by marked difficulty in the delivery of the head, so that it is probable that trauma was a factor in their death. The remaining 3 cases were delivered easily but rapidly, and were alive at birth, so that trauma and asphyxia must both be considered operative. In this connection, it should be noted that Potter (16) has learned from experience that a prolapsed cord, not pulsating, does not necessarily imply fetal death, or even dangerous fetal asphyxia and he, therefore, does not hurry delivery because of that complication.

An important cord complication, namely, cord around neck or body of baby, is described only once in the present series (Case 10). This baby showed "asphyxia pallida," but autopsy disclosed intracranial hæmorrhage, spinal cord laceration, and fractured vertebra.

Clinicians agree in fearing this complication as a possible cause both of asphyxia and injury, in every type of delivery. La Fetra (12) has reported a series of cases in which this complication was attended with a high percentage of cerebral hæmorrhage.. When the cord is tightly around the neck, it is clear that the baby is subjected to: (1) danger of asphyxia; (2) danger of marked venous congestion of the brain, a predisposing and contributing cause of intracranial hæmorrhage, the exciting cause of which is trauma.

Placental and umbilical cord abnormalities must be considered possible causes of fetal asphyxia. Yet only 1 of 10 cases verified the possibility. In the remaining cases, the placenta and cord complications seemed to have incited the operator to unusual speed and violence with resulting fatal injuries to the babies. To paraphrase Holland: "Though some babies be killed by asphyxia, it seems a pity to kill them twice!"

Chief clinical difficulties in breech deliveries. Difficulty in the delivery of the aftercoming head was described in 57 per cent of the cases, difficulties with arms and shoulders in 25 per cent, and difficulty from an incompletely dilated cervix in 11 per cent.

Two errors of obstetrical judgment stand out as predisposing to these difficulties: (1) A hurried conduct of labor and delivery. It is well known that a hurried labor and delivery are prone to be complicated by an incompletely dilated cervix, extended arms, and an extended head. The time element in breech deliveries will be discussed more fully below. (2) Misjudgment of the pelvis. A contracted pelvis is prone to cause extension of arms and head in addition to offering more obstruction to the diameters of the passenger. An abnormal pelvis was noted in 50 per cent of the version and breech deliveries, and in 6 per cent of the primary breech deliveries, making a total of 35 per cent in the combined series of 36.

The outstanding errors of technique in extraction are likewise two, and are predisposed to by the tradition of necessary haste: (1) failure to accommodate in delivery the long axis of the child to the axes of the pelvis, thus causing dangerous angulations; (2) failure to accommodate the longest diameters of body, shoulders, and head to the longest diameters of the pelvis, thus causing the necessity of a dangerous degree of suprapubic pressure and traction.

Asphyxia pallida. This term has been traditionally applied to babies which at birth are white, limp, have slow feeble heart action and make little or no attempt at respiration. In the series of 38 breech deliveries, 16 babies showed this condition; 11 of the 16, or 68 per cent, showed evidence of severe birth trauma, but none of asphyxia. In the remaining 5 cases, there were some clinical and pathological evidences of asphyxia, but there were also evidences of concomitant trauma.

The foregoing evidence suggests that many, if not most, of the babies born in a condition of so-called "asphyxia pallida" in breech deliveries are rather in a condition of fetal collapse and shock, the result of injury. Ehrenfest (7) expresses a similar opinion as follows: "The majority of the actual cases of fatal traumatism still are included in the figures assigned to prematurity, congenital debility, *and most of all to asphyxia.*"

"Not only many of the intracranial, but also most of the fatal injuries of the vertebral column, spinal cord, or abdominal viscera, can be discovered only at autopsy—an autopsy, as must be emphasized, in which the skull is opened in a specific manner and the routine examination includes the vertebral column, the spinal cord, and such abdominal organs as the suprarenal bodies.

"Without an autopsy, the cause of death so often is incorrectly ascribed to asphyxia, because the majority of seriously traumatized infants exhibit a clinical picture which closely resembles that generally considered as typical for deep asphyxiation."

Death from asphyxia can occur only when the baby's blood contains a sufficient amount of carbon dioxide for a sufficient length of time. In breech deliveries, this may be caused by placental or umbilical cord abnormalties, or from asphyxia of the mother. The important placental abnormalties are: (1) placenta prævia; (2) premature separation of placenta. The important cord abnormalities are: (1) prolapse; (2) cord about neck or

Fig. 3. Fracture of third thoracic vertebra. Complete laceration of spinal cord, version and breech delivery. Case. 13.

body of baby; (3) prolonged compression of umbilical cord by the body or head of the baby during delivery; (4) knots of cord, rupture of cord, etc.

Halliburton (8) has described the typical findings in death from asphyxia as follows: "After death from asphyxia it is found, in the great majority of cases, that the right side of the heart, the pulmonary arteries, and the systemic veins are gorged with dark blood; and the left side of the heart, the pulmonary veins and the arteries are empty."

In addition, one frequently finds evidence of attempted respiration. These evidences are chiefly the presence of blood-tinged mucus and liquor amnii in trachea and bronchi. There may also be petechial epicardial, and epipleural hæmorrhages.

The following postulates must be met before the diagnosis of fetal death from asphyxia is made: (1) that strong evidence be present of one or more of the abnormalities in the mother, baby, or delivery, causative of fetal asphyxia; (2) that autopsy performed according to certain standards of technique show evidences of asphyxia and none of important birth injury, or other adequate cause of death.

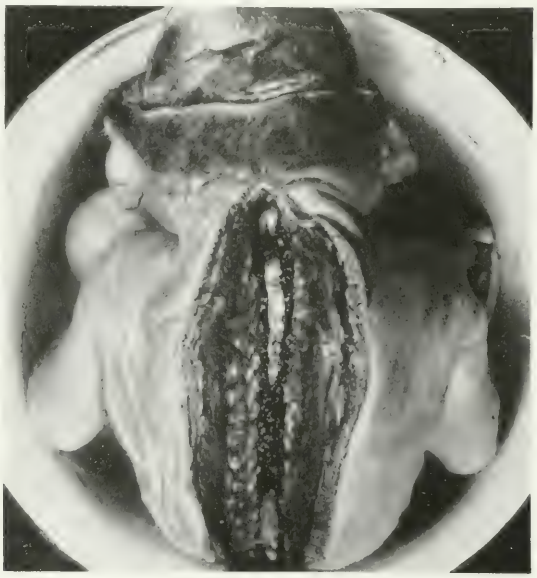

Fig. 4. Intranatal death in breech delivery with fracture of cervical vertebra and marked extradural hæmorrhage about the spinal cord.

Time element in breech deliveries. In the series of breech deaths, the average time of delivery from foot to head in 17 of 36 cases was 6 minutes. The average time of delivery from navel to mouth in 8 cases was 4 minutes. These figures are below the traditional time limits imposed by fear of asphyxia, yet these babies were lost, many of them with the conventional diagnosis of "asphyxia pallida"; whereas, as has been pointed out, they were actually killed by trauma in delivery. In other words, frantic haste as opposed to deliberate skill has been the clinical error involved.

A similar conclusion has been reached by Ehrenfest (7) in the following words: "Fear of compression of the umbilical cord too often prompts the obstetrician to hurry unnecessarily with the extraction of the aftercoming head. He should remember that in the management of a breech labor, neglect to perform the various manipulations gently and precisely, implies greater danger to the child than mere asphyxiation."

Potter (16) and others have proved that 15 to 20 minutes may be allowed to pass from birth of navel to the mouth. Thus Potter has written: "I never hasten delivery after the umbilicus comes into view because experience has taught me that haste is unnecessary; that severe complication such as extension of the arms and of the head are very apt to take place when we interfere with the natural forcing powers at this particular stage of delivery.

"Experience has taught me that nearly all of the babies begin to breathe spontaneously when let alone, provided the heart is beating."

In a personal communication Dr. Potter wrote: "I place no limit upon the time allowed to pass from the birth of the navel until the child is delivered, in breech deliveries, or in extraction following version. I am governed entirely by the condition of mother and child. Today, I took 12 minutes with no injuries to the child, a loop of cord being exposed the entire time—*not pulsating*. Frequently, 8, 10, or 15 minutes is required, the longest time being 23 minutes with no injury to the child. I cannot help but feel that great damage to both mother and child was done by the hasty manner which you and I were taught to employ."

Holland (10), likewise, has indicated that the old tradition of imperative haste in breech delivery, and the tradition that asphyxia was the usual cause of death, was responsible, in large part, for the injuries found. He concluded in part as follows: "The death rate of breech fetuses will fall when it is realized that they are killed, not by cord compression, but by excessive cranial stress, and when this knowledge has brought about a corresponding change in our present obstetrical procedures. A new rule must be adopted for breech delivery. Instead of using forceful haste, we must be deliberate and deliver gently and gradually the after-coming head."

The foregoing evidence shows sufficiently that the traditional estimate of the margin of safety in time during breech deliveries, has been greatly underestimated. It is probable that umbilical cord compression is seldom complete during breech deliveries. It is probable also that the unborn baby which has never breathed is more resistant to asphyxia than is an adult animal.

CONCLUSIONS

1. Birth injury and shock in breech deliveries cause greater fetal mortality and morbidity than asphyxia.

2. Unnecessary haste in breech extractions, prompted by fear of fetal asphyxia, often causes obstetrical complications leading to birth injuries.

3. The diagnosis of death from asphyxia in breech deliveries is only justified when (a) there is strong clinical evidence of asphyxia, but none of injury; and, (b) when complete autopsy shows characteristic signs of asphyxia, but none of injury.

4. The incidence of breech extraction may be diminished by (a) the practice of external version when possible; (b) and by stricter limitation of the indications for version and breech extraction.

5. The high mortality and morbidity of breech deliveries may also be reduced by:

a. A management of labor and delivery that will effect full dilatation of the soft parts.

b. Accommodating, in delivery, the long axis of the child to the axes of the pelvis, thus avoiding dangerous angulations. And by accommodating the longest diameters of the body, shoulders, and head to the longest diameters of the pelvis, thus avoiding a dangerous degree of traction and suprapubic pressure.

NOTE.—This article and that by Bronson Crothers, M.D., on "Changes of Pressure Inside the Fetal Craniovertebral Cavity," p. 790, are a part of a symposium read before the New York Academy of Medicine, Sections of Obstetrics and Pediatrics, March 9, 1923, which included also the article by George Hope Ryder, M.D., on "Breech Presentations Treated by Prophylactic External Version; Report of Fifty-Nine Breech Presentations so Treated," published in the November, 1923, issue, p. 660.

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DEPARTMENT OF TECHNIQUE

REGIONAL ANÆSTHESIA IN GYNECOLOGY AND OBSTETRICS[1]

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THE last few years have shown a steadily increasing interest in anæsthesia in the entire field of surgery. New methods of administering general anæsthetics have been developed and the dangers considerably lessened. The evolution has also been marked by the development of new anæsthetic drugs, of various combinations and sequences. These have served to make the period of induction more pleasant, increased the efficiency of the course of anæsthesia, and have eliminated many of the unpleasant and dangerous after-effects during the period of recovery. The improvement in methods of local anæsthesia has been no less marked, and its field of usefulness has greatly increased. Continued efforts to broaden the field of operative work which may properly be performed under local anæsthesia have gradually evolved the newer methods of field block and nerve block technique, and have tended to establish the entire system on a scientific basis. The domain of operative achievement under local anæsthesia has grown to such an extent that it is difficult definitely to limit its practicability when it is in the hands of a surgeon skilled in its use.

Since the possibility of spinal anæsthesia with cocaine was first suggested by Corning, there have been periods of enthusiastic trial and complete disuse of the method. Owing largely to the work of continental surgeons, notably Bier and Tuffier, the method was first generally introduced, and followed by a wave of enthusiasm. Like all other radical innovations, it was followed by a period of depression, when accumulated statistics demonstrated that the method could not compare in safety with the methods of general anæsthesia. The popularity of the method was revived when the less toxic drugs, stovaine and tropococaine, were introduced. Stovaine has been perhaps most widely used, but has proved unreliable probably because of its irritating qualities, and is now less used than formerly. Tropococaine is less a local irritant than stovaine, and proved more satisfactory in the days when it was readily obtainable.

Within the last few years the results from spinal anæsthesia have improved, and clinical experience with the method vastly widened. The improvement has been due, in part, to the employment of the least toxic and irritating local anæsthetic drugs, novocain and apothesine, in the subarachnoidal injection. Novocain has, on the whole, enjoyed the greatest popularity. Its toxicity is slight and it has good anæsthetic properties. The properties of apothesine are essentially similar to those of novocain; the anæsthetic qualities are as good and the toxicity is very slight. These drugs, when dissolved in the patient's own spinal fluid, slowly injected in part, with aspiration and reinjection three or four times to mix the solution more thoroughly with the fluid within the spinal canal, probably constitute the safest of the many present day methods of spinal anæsthesia.

In spite of the improvement in the drugs and technique of spinal anæsthesia, its employment has not become widespread. Its legitimate use has perhaps been greatly retarded by the carelessness and ignorance of many who have attempted to use it, as well as by the prejudice of those who have had no experience with the method. Exaggerated reports of the innocuousness of the method and attempts to make it the universal anæsthetic have served only to discredit the procedure, where its use might otherwise be valuable. Such statements for example as "absolutely safe," "without mishap," "anæsthetic of choice," and so forth, are applied to spinal anæsthesia in the same publications which also detail methods of resuscitation in cases of collapse. Even those who use it most insist that one must be prepared to meet emergencies. Al-

[1] Read by invitation, before the Chicago Gynecological Society, April 20, 1923.

though beneficial, the method may be followed by sudden danger. In the course of an otherwise successful surgical procedure the vasomotor apparatus may give way. The resulting fall in blood pressure is rapid and sometimes extreme. The patient is pale, sweating, and distressed. Whether or not this condition is collapse from shock, the picture is very similar, and while these symptoms usually pass away in the course of a comparatively short time, their presence is very disquieting. It is impossible to predict in which cases such symptoms are liable to occur.

Clinical experience has shown spinal anæsthesia to be more dangerous at the higher levels of the spine, so that the present tendency is to limit its use to operations below the umbilicus. It still maintains its place in pelvic surgery, and its use in genito-urinary surgery in males has become more widespread, while a few operators employ it in all cases possible. The indications for its use are therefore quite indefinite. While undoubtedly much progress has been made in the technique and the results obtained, the mortality is still too high to recommend it as a method of choice. It has been the custom to limit its use to those operations in which, for certain reasons, general anæsthesia is contra-indicated, and even then Braun maintains that it should be confined to operations in connection with the lower segments of the spine, and should never be used in operations as high as those on the stomach.

LOCAL ANÆSTHESIA IN GYNECOLOGY

The field of gynecology should thus offer a comparatively safe location for the use of spinal anæsthesia, in the presence of contra-indications to general narcosis. Before electing to use spinal anæsthesia, however, the question of the possibility of employing local anæsthesia must first be decided. As spinal anæsthesia is admittedly less benign than local or regional anæsthesia, it should not be employed in those operations in which the latter methods will suffice. Taking into consideration the fact that field block and sacral nerve block procedures have greatly broadened the limits of gynecological operative work which may properly be performed under local anæsthesia, the indications for spinal anæsthesia should be correspondingly restricted.

Mental ease and physical comfort. Equally important as the technique of local anæsthesia is the mental ease and physical comfort of the patient. Women, as a rule, are more apprehensive and more easily frightened than men. This condition is notably worse in women who have been

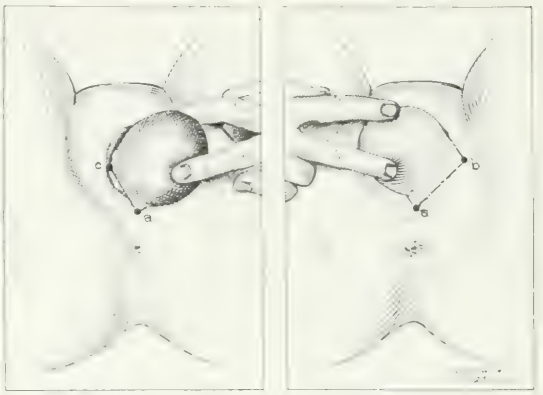

Fig. 1. Circular field block at base of vulval tumor (after Braun).

subject to considerable worry from their various afflictions, and they often make poor subjects for any form of local anæsthesia. Added to the terror of the operation is the embarrassment at being placed in the lithotomy position with perineum exposed. These subjective sensations should be allayed beforehand by the proper hypodermic medication of pantopon and scopolamin, just sufficient to convert an attitude of fear and worry to one of indifference.

The gynecological position on the operating table is at best quite uncomfortable, and may cause pain, particularly in obese women. If the patient shows signs of restlessness and discomfort during the course of the operation, it is more likely due to the position of the legs than to the manipulations of the operator, especially when the legs are suspended by the usual foot straps rather than being supported by the more comfortable leg holders. The adjustable leg holders with pneumatic cushions as employed by Farr greatly contribute to the comfort of the patient in this position. Her comfort may be further enhanced by the employment of deeper mattresses on the operating table and the use of regular pillows. With proper preliminary hypodermics, special provision for the patient's comfort on the table, and a tactful assistant to sit at her head and control her attention, a patient who otherwise would be regarded as a poor subject for local anæsthesia may be converted into an enthusiastic advocate of the method.

Surgery of the floor of the pelvis and of the viscera, in the female, forms a large part of the operative work of the general surgeon of the present time. The perineum offers a wide field for operations under local anæsthesia. The external and readily accessible parts are quite

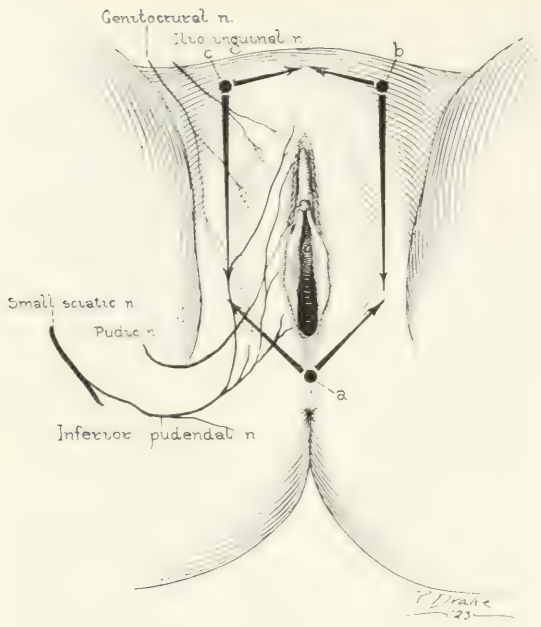

Fig. 2. Field block of entire vulva. *a*, perineal wheal; *b* and *c*, pubic wheals.

suitable for infiltration methods, while the deeper and more extensive operations may with skill and gentleness be painlessly performed under field block, or nerve block methods. Operations in this highly sensitive area must be performed with great care, and it naturally follows that any method of local anæsthesia in this region must be executed with delicacy, accuracy, and thoroughness to insure a successful outcome.

Operations under terminal infiltration and field block. The superficial operations on the perineum and anus may be quite satisfactorily performed under terminal infiltration. Cysts and solid benign tumors of all kinds, both on the labia majora and labia minora may be removed by circular field block, with deep fanwise injections of 0.5 per cent procain-adrenalin solution under the tumor (Fig. 1). A circular plane of anæsthetic fluid is thus projected from points around the base, entirely underneath the tumor, which interrupts conductivity in all nerve filaments passing through it. Complete extirpation of the vulva, as for example in elephantiasis, may also be performed by circular field block (Fig. 2). Injections may be made from three wheals: the perineal wheal *a*, is between the anus and vulvar orifice, while pubic wheals *b* and *c*, mark the pubic spines. From these points, fanwise injections are made in the direction of the arrows and toward the vulvar orifice, while the two fingers of the left hand in the vagina guard the position of the needle with respect to vaginal mucosa. In case of malignant tumors of the vulva it is more advisable to anæsthetize by a method which will be described.

Cervical and anal polypi and other benign superficial tumors of the perineum may be removed by infiltration of their bases. Urethral caruncles can be painlessly removed by surface anæsthesia with cocaine (7). A swab of cotton on a toothpick, saturated in 10 per cent cocaine solution and lubricated with a soluble lubricant, inserted into the urethra and left for 10 minutes, will completely anæsthetize the caruncle.

Superficial perineal fistulæ and fistula *in ano*, when not too painful and in which the course of the fistulous tract is definitely determined, may be encased by a wall of anæsthetic solution (Fig. 3). In most cases of fistula *in ano*, however, the surgeon must resort to other methods. When the fistulous tract must be explored and when dilatation of the anus is necessary, a considerably larger field must be anæsthetized. Infiltration may also be difficult, because of the great amount of scar tissue and tortuosity of the tract, particularly when previous operation has been performed.

In most cases of hæmorrhoidectomy and anal fissure, circumferential injection of the terminal rectum as first practiced by Reclus, is very satisfactory. The technique is so simple and quickly

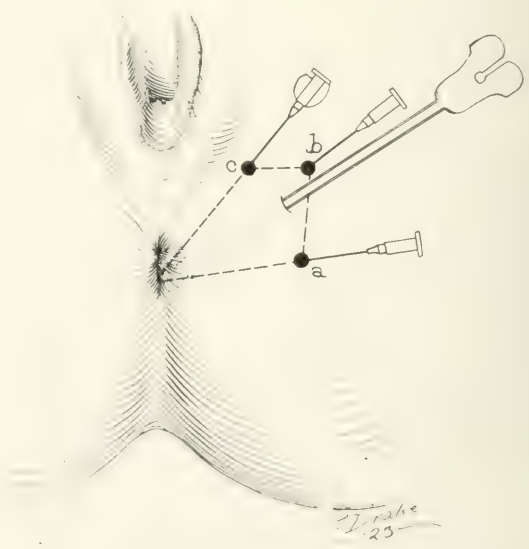

Fig. 3. Technique of injections for superficial fistula *in ano*.

executed that many surgeons employ it in preference to a general anæsthesia (8). A diamond-shaped area is marked off by four wheals (Fig. 4) with the anus in the center. From these points a 0.5 per cent solution of procaine-adrenalin is injected with an 8 centimeter needle. Deep, fanwise injections are made from these four points directed by a guiding finger in the rectum. These points are then connected by subcutaneous injections, so that when the technique is accurately performed, a wall of anæsthetic fluid the shape of a hollow cylinder, has been made to encase the terminal rectum (Fig. 5). Usually 100 to 125 cubic centimeters of solution is sufficient. At the conclusion of the injection the sphincters are flaccid, and the operation may begin within 5 minutes. Often in cases of anal fissure and in acutely inflamed hæmorrhoids, however, the finger cannot be tolerated in the rectum because of intense pain. The practice of inserting the finger into the rectum is not without risk of septic contamination, so that other methods are often employed.

Perineorrhaphy for small perineal tears may be performed under local infiltration of the tissues in the immediate neighborhood of the defect. Infiltration is begun from a dermal wheal in the middle of the mucocutaneous juncture, and continued along it somewhat farther than the desired extent of the incision on each side (Fig. 6). With the aid of a guiding finger in the rectum, deep, fanwise injections are made into the recto-vaginal septum, and extended to the bony walls of the pelvis laterally. From 100 to 150 cubic centimeters of 0.5 per cent procaine-adrenalin solution is employed, depending on the extent of the defect. In case of a large defect, however, the retraction necessary for exposure in a rather deep cavity, and the pull necessary in approximating muscles and fascia often produces intolerable pain. For this reason repair of extensive perineal tears is more effectively performed under nerve block methods.

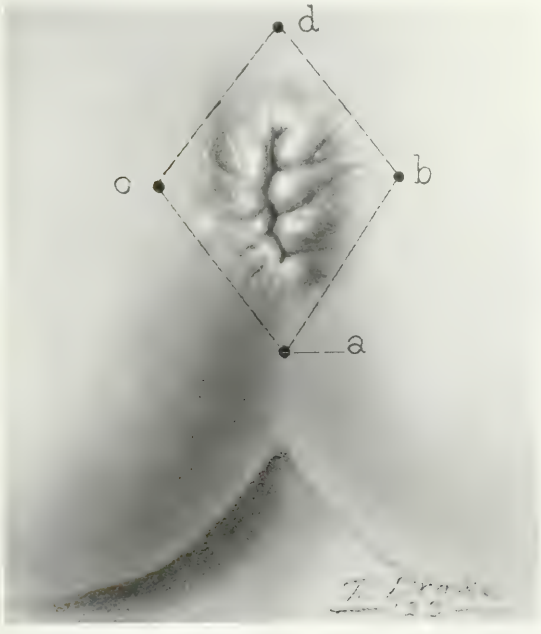

Fig. 4. Circular injections around terminal rectum and anus.

Fig. 5. Circuminjection of terminal rectum.

SACRAL BLOCK METHODS

The performance of more extensive operations on the pelvic floor and viscera than those thus far described, is often beset with difficulties when attempted under local infiltration methods. The most difficult problem in the deeper operations is the prevention of traction pain. Seizing the levator muscles may cause deep-seated pain which cannot be overcome by additional injections. In bringing the uterus down for tracheolorrhaphy, and in Watkin's interposition operation or vaginal hysterectomy, traction causes pain from tension on the pelvic peritoneum and broad ligaments. In other regions of the body infiltration could be made to include a wider area, but this is impracticable in the deeper perineal operations because of insufficient exposure and lateral limitation of operative field by the bony pelvis.

Fig. 6. Fanwise injections into the rectovaginal septum for perineorrhaphy.

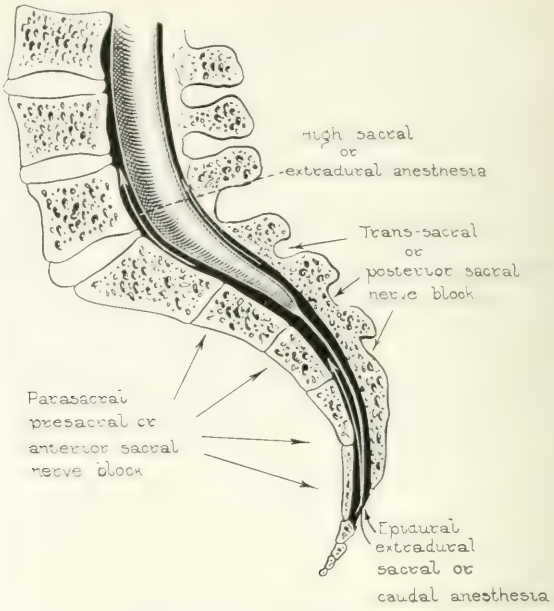

Fig. 7. Diagram illustrating different methods of approach in blocking sacral nerves.

By blocking the sacral nerves close to their points of exit at the sacral canal before the plexuses are formed, a much wider and deeper area may be anæsthetized, thus greatly facilitating surgical manipulation. Block of these nerves may be accomplished by (1) paraneural injection of the nerve trunks at their exits from the anterior sacral foramina, called parasacral, presacral, and anterior sacral nerve block; (2) the injection of an anæsthetic solution into the epidural space of the sacral canal, the procedure being known as epidural, sacral, extradural, and caudal anæsthesia; and (3) injections into the posterior sacral foramina, called posterior sacral, or transsacral nerve block (Fig. 7).

PARASACRAL NERVE BLOCK

In parasacral anæsthesia the patient is placed in the lithotomy position and injections made through the perineum into the hollow of the sacrum anteriorly. Dermal wheals are raised (Fig. 8) about 2 centimeters from the median line, at the level of the sacrococcygeal articulation. A longer needle, from 8 to 10 centimeters, is then introduced, and the way is felt past the edge of the sacrum and along its anterior surface, parallel to the median line to the height of the second foramen. The first sacral foramen is located by a separate insertion in which the needle is directed toward the innominate line. Both sides are similarly injected, after which a final infiltration of tissues between the coccyx and rectum is made. Usually about 100 cubic centimeters of 1 per cent procaine-adrenalin is required, although more recently Braun recommends the use of 0.5 per cent, 100 cubic centimeters being injected on each side. During the injections a finger in the rectum may be used to guide the direction of the needle.

The main objection to this method is the uncertainty of results. While Braun, the originator of the method, recommends it for operative work on the perineum, he also infiltrates locally, thus showing the inadequacy of the method when used alone. Very few series of cases are reported demonstrating the efficiency of the method. Tolken reports a series of 43 cases in none of which was it necessary to resort to inhalation narcosis. There was considerable pain in two instances, however, and he also usually infiltrated locally, so that there may have been other cases in which anæsthesia from the parasacral block alone was insufficient.

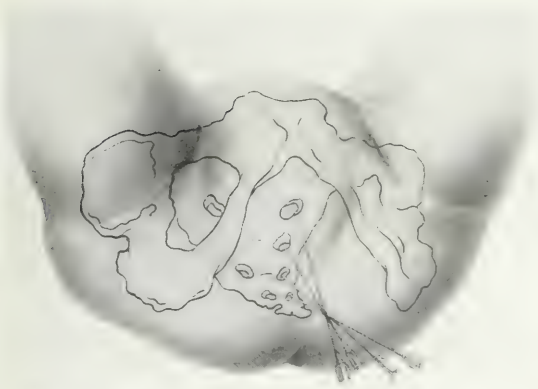

Fig. 8. Parasacral nerve block, showing method of approach to anterior sacral foramina.

The passage of needles through the perineum according to the parasacral or presacral method is not without an element of local danger. The rectum, even when empty, fills the concavity of the sacrum, and when it is bound down or partially fixed by pelvic adhesions, or displaced by pressure from neighboring structures, the risk of perforation cannot be denied. Infection may also be spread by the passage of the needles when a septic area is traversed. Similarly, the possible dissemination of cancer cells from secondarily involved perirectal lymph glands in cancer of the rectum must be kept in mind.

SACRAL NERVE BLOCK BY EPIDURAL INJECTIONS

Blocking the sacral plexus by intrasacral injections is a very simple and practical procedure. The anæsthetic solution is injected into the epidural space, the lower part of the sacral canal, a cavity from 6 to 9 centimeters long between the second and the fifth sacral vertebræ, and below the termination of the dura (Fig. 9). The upper portion of the sacral canal is occupied by the dural sac, which terminates at the lower border of the second sacral vertebra, while the lower end of the epidural space is marked by the hiatus sacralis, a triangular opening on the dorsum of the sacrum just above its juncture with the coccyx. This hiatus, which is due to failure of the dorsal arches of the sacral segments to coalesce, varies greatly in size depending on the degree of closure of the dorsal arches. If only the last or fifth arch is wanting, the opening is small. Cases have been encountered in which partial closure of the fifth arch may leave an opening just sufficient to admit a spinal needle. It is in such cases as these that ossification in the occluding sacrococcygeal membrane completely closes this aperture. Ordinarily, however, the hiatus is triangular in shape, the base being limited by the sacral cornua, usually 1 centimeter apart, while the apex is marked by the fourth sacral spine, about 1.5 to 2 centimeter distant from the base (Fig. 10).

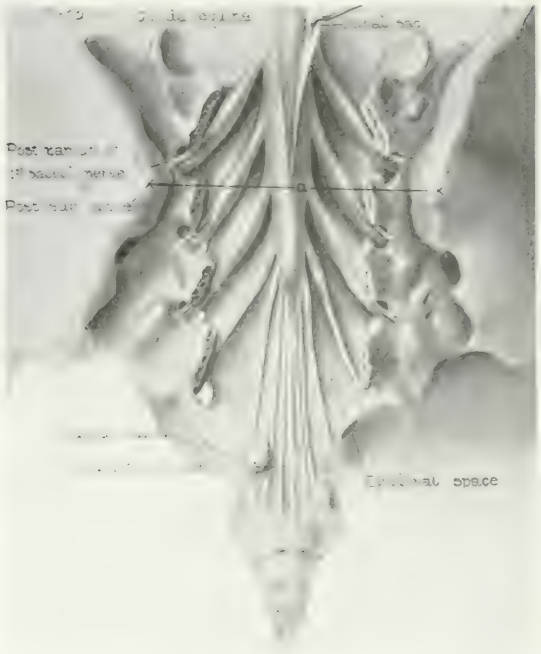

Fig. 9. Anatomy of epidural space. Sacral laminæ have been entirely removed. The fatty areolar tissue and lymphatic and venous plexuses normally filling up this space have also been removed, leaving the dura and nerve trunks in position.

In making the injection, the patient is placed in the ventral recumbent position with a cushion under the hips, which elevates the buttocks and accentuates bony landmarks (Fig. 11). The index finger of the left hand then identifies the sacral cornua on either side, and somewhat higher the fourth sacral spine, thus defining the hiatus. A dermal wheal is placed within this triangle, and the subcutaneous tissues and sacrococcygeal membrane infiltrated. A fine spinal puncture needle is introduced through the skin with bevel upward, and at an angle of from 20 to 30 degrees. The needle will be felt to pierce a dense membrane, then strike the bone of the anterior wall. It is then withdrawn from 1 to 2 millimeters, depressed from 20 to 30 degrees farther, and advanced upward 3 to 5 centimeters. If blood or spinal fluid escapes on removing the stylet, or on aspiration, the needle should be slightly withdrawn, or its position changed until these cease to flow.

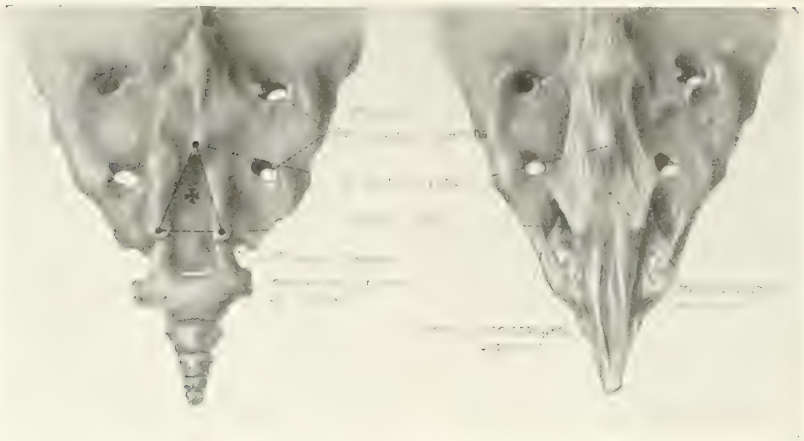

Fig. 10. Anatomy of the sacral hiatus. In the figure to the left (+) marks the site of puncture for entrance into the canal. To the right the hiatus is covered with the sacrococcygeal or obturator membrane.

The injection of the solution is then made very slowly and gently, the needle being gradually withdrawn, or its position changed, until, at the completion of the injection, the needle is just inside the sacrococcygeal membrane.

The quantity and percentage strength of the novocaine solution employed varies in the hands of different operators. Laewen, who first demonstrated the practicability of the method for operative work, recommends from 20 to 25 cubic centimeters of a 2 per cent solution of novocaine and adrenalin, with the addition of sodium chloride and sodium bicarbonate. He also employs from 25 to 35 cubic centimeters of a 1.5 per cent solution of novocaine. Many other formulas have been proposed. Schlimpert and Schneider employed 50 cubic centimeters of 1 per cent strength for gynecological and obstetrical work. Clinical experience indicates more favorable results with larger amounts of the weaker solutions.

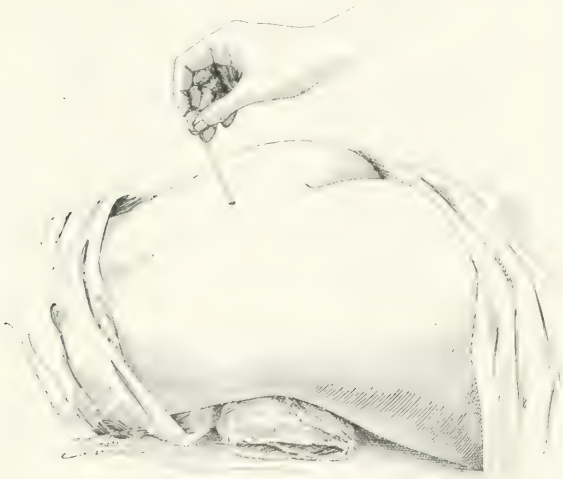

Fig. 11. Position of patient and operator for injection of sacral nerves by the posterior route.

The chief disadvantage of sacral anæsthesia in gynecological operations is its failure in a certain percentage of cases. While the proportion of failures will vary according to the accuracy with which the technique is performed, the method is accompanied by a certain incidence of failures even in the hands of the expert. The anæsthetic medium, because of the curvature of the sacrum, is deposited nearer the posterior wall than the anterior, while the anterior divisions of the nerves lie contiguous with the anterior wall. Near the middle point of the space, the nerve trunks are enclosed in tubular prolongations of the dura as they leave the dural sac, thus protecting them from contact with the anæsthetic medium. As the trunks proceed laterally, however, the contribution of the dura to the perineum tends to diminish, until at the lateral foramina it is no longer evident. It is at this point, then, that the nerve trunk will be most easily penetrated by the anæsthetic solution. The solution must thus diffuse through the content of the epidural space, consisting of fatty areolar tissue, and lymphatic and venous plexuses, before physiological block of the nerve trunks will be effected. Kehrer, in 140 gynecologic cases, found the anæsthesia insufficient in 10 per cent, and absent in 8 per cent. These operations included most operations on the entire pelvic floor and viscera. It was usually the deeper

operations, however, such as vaginal hysterectomy in which anæsthesia was insufficient.

Even when successful, the height of anæsthesia is variable, extending from the anal margin in light anæsthesia to complete motor paralysis of the legs in the extreme cases. It is obvious that anæsthesia will appear first in the lowest of the sacral nerve trunks, because these are smaller in size, and have a longer course nearer the middle line in the portion of the sacral canal which is smallest in volume, all features favoring bathing of the nerve trunks with the anæsthetic solution. If one who uses sacral anæsthesia is ready to supplement the sacral blocking by local infiltration, when required, the failures do not work so much of a hardship.

Another disadvantage is the appearance of toxic symptoms. All patients react more or less to the injection of procaine-adrenalin solutions into the sacral canal, the severity of the reaction being proportional to the strength of the solution used, the quantity of adrenalin, the quantity of solution, and the speed with which the injection is made. Rapid pulse and palpitation of the heart are the most frequent symptoms, and may be accompanied by an increase in respiration and dyspnœa. Nausea and vomiting, and sometimes even collapse, may occur. Such untoward symptoms start during the injection and last only a few minutes, clearing up without actual treatment, if the injection is stopped for a time and resumed very slowly.

Sacral anæsthesia is valuable in the more superficial operations on the perineum and terminal rectum. It is the method of choice for cystoscopy with or without fulguration, for radium treatment, for the carcinomatous bladder, and for litholapaxy and painful proctoscopy. One of the most satisfactory fields for sacral anæsthesia is in inflamed bladder, especially of tuberculous origin. Occasionally in fulgurating in cases of benign papilloma of the bladder, the mucosa is too irritable to permit sufficient distention or extensive fulguration. Sacral anæsthesia is usually satisfactory in these cases permitting an unhurried, complete examination. In case of litholapaxy, it is necessary to remember that the musculature of the bladder is partially paralyzed and cannot readily expel the water and particles of crushed stone. For urological manipulative work, partial failures do not cause great inconvenience, since these procedures may be accomplished with an anæsthesia insufficient for operative work.

Dilatation and curettage, cauterization of the cervix, and insertion of the Baldwin tube, may be painlessly performed, provided gentleness is used in manipulation. The effect of severe traction on the cervix in bringing the uterus down may be transmitted to territories beyond the anæsthetized area, however, the sterilization of the vaginal cavity and insertion of vaginal retractors is painless. This method is more efficient than injections around the cervix and into the parametrium. Epidural injections are also indicated in the treatment of sciatica, coccyalgia, sexual neurosis, tabes dorsalis, and in intractable pruritis of the anus and vulva. Dilatation of anal strictures, hæmorrhoidectomy, and excision of and superficial fistula-in-ano may be successfully performed in most cases. When perfect anæsthesia results, relaxation of the anal sphincters is a characteristic feature. The occasional failures to produce anæsthesia as high as the second sacral nerve, and the slowness with which the anæsthesia sets in are disadvantages which may be overcome by peri-anal infiltration when needed.

TRANSSACRAL NERVE BLOCK

Block of the sacral nerves by the transsacral method, in the opinion of many operators, has overcome many of the inconveniences and disadvantages of parasacral and sacral anæsthesia (28). The anæsthesia produced by the parasacral method is said to be similar to that produced by the transsacral method, since the nerves involved are the same, except that in the parasacral method the posterior primary divisions are not reached. Differences exist, however, in the quality of the anæsthesia and its duration, and this should be remembered when comparing the results of both procedures (24). In the transsacral method the increased pressure on the nerve trunks and the limitation of lateral spread of the solution by the bony walls of the foramina, which also results in retention of the fluid within the foramina for a longer time, establishes more favorable conditions for rapid and prolonged anæsthesia. The presacral method is anatomically less precise and less aseptic.

Clinical experience indicates that the best results are obtained by the use of a very low epidural injection for anæsthesia of the fifth sacral and anococcygeal nerves and transsacral block of the upper four sacral nerves (29). The association in this manner of the epidural and transsacral methods has been termed by Labat "sacral block." This term has been previously applied to blocking of sacral nerves by epidural injections (16), so that the introduction of a double meaning instead of clarifying the terminology in a field where there is already a plethora of names, adds to the confusion.

This technique gives a uniformly satisfactory anæsthesia, the height of which is definitely limited. Injection of 20 to 25 cubic centimeters of a 1 per cent procaine-adrenalin solution into the epidural space is performed, as already described. This usually creates more favorable conditions for transsacral block in that the manipulations are almost painless, due to anæsthesia of posterior divisions. With the patient in the same position (Fig. 11), transsacral block is carried out with the same solution.

In locating the lateral sacral foramina (9), use is made of the fact that they lie in the same straight line, and are nearly equidistant from each other (Fig. 9), the distance decreasing somewhat from above downward, and that their position bears constant relationship to the most prominent bony landmarks of this region, the posterior superior iliac spines and the sacral cornua. A dermal wheal, placed just laterally and below the sacral cornu, locates the sacral notch on the lower margin of the sacrum in which the fifth sacral nerve lies. Palpating the most prominent point of the posterior superior iliac spine, with the left hand, another dermal wheal is placed 2.5 centimeters medial, and about 1 centimeter downward, which marks the position of the second sacral foramen (Fig. 12). The space between these two wheals is then divided into three parts by two more wheals, then a fifth is placed the same distance above the second and in the same straight line, completing the superficial designation of the five foramina.

Search for foramina is then made by advancing the needle directly downward and somewhat inward in a direction thought to be perpendicular to the tangent of the sacrum at that point (Fig. 11). It usually comes in contact with bone during the first few attempts, the distance from the skin to the posterior surface of the sacrum being estimated in this way. When, after repeated search, the needle seems to perforate a membrane, advancing farther than before, still without encountering bony resistance, it has passed into the foramen. Greater inclination of the needle to the skin surface is necessary in searching for the highest foramina, due to the downward curvature of the sacrum, and greater thickness of overlying soft tissues. The size of foramina and nerve trunks also decreases from above downward, necessitating the injection of larger amounts of solution in the higher foramina. The quantity for each successive foramen is thus reduced by 1 cubic centimeter, that is 7, 6, 5, 4, and 3 cubic centimeters for the first to the fifth foramina respectively. From 60 to 80 cubic centimeters of 1 per cent solution is sufficient for complete transsacral block. Anæsthesia is usually complete at the conclusion of the last injection, and lasts from 2 to 4 hours. There has been no untoward reaction of the patient in our experience, provided the correct technique was employed and operation limited to pelvic floor and viscera.

SCOPE OF OPERATIVE WORK

The extent of anæsthesia is best appreciated by a consideration of the operations that have been painlessly performed with this method on the pelvic floor and viscera of the female. While all of the operations herein detailed do not properly belong to the field of gynecology, their consideration is of value in that the parts concerned are innervated by sacral nerves and constitute a part of the pelvic floor, all of which is involved in obstetrics. In surgery of the rectum it has been repeatedly employed in hæmorrhoidectomy, the usual type of operation being clamp and cautery of the internal hæmorrhoids, and excision and suture of the external. Relaxation of the sphincters and muscles of the pelvic diaphragm are features especially favorable to surgery of the terminal rectum. Plastic operations on the anal sphincters, removal of rectal polypi, dilatation of rectal strictures, excision of specimens from rectal tumors for diagnosis, and amputations of the prolapsed rectum, have been performed many times under block of the lower four sacral nerves by the posterior route. It has been employed in posterior resection of the carcinomatous rectum with removal of the coccyx and fifth sacral segment. The single stage resections with sacral anus, and the second stage resections after preliminary colostomy have been performed; for this operation all five sacral nerves are injected, it being unnecessary to inject the lower three lumbar nerves, as insisted on by certain authors. Block of the sacral nerves alone anæsthetizes the pelvic peritoneum, so that it can be opened and removed from the rectum and closed again painlessly. If there is intolerable pain during the operation, which is unusual, it is due to the traction on the bowel necessary to bring a high-lying growth down so that clamps may be applied above it. This pain is probably due to excessive pulling on the mesosigmoid, involving the hypogastric plexuses of nerves, and cannot be controlled by block of the three lower lumbar nerves. One per cent procaine-adrenalin solution is usually employed, although in old, feeble, and cachectic women, it is not necessary to employ the full strength of dose, as for the more vigorous patient. Anæsthesia is more readily induced

Fig. 12. Transsacral nerve block. On the right side is shown the relation of cutaneous points to posterior superior spines and sacral cornua. Dissection on the left side shows posterior divisions of sacral nerves and sacral foramina. Note the position of the interspinous line with regard to first and second sacral foramina.

in the feeble, so that the strength of the solution may be reduced to 0.5 per cent, and a slightly greater quantity employed.

The patient's position on the table is awkward, and precautions should be taken to make it as comfortable as possible. Special care should be exercised in the two-stage operation, so that weight on the preliminary colostomy does not cause pain. Often this is the only thing of which the patient complains during the entire operation. Growths have been extirpated as high as the rectosigmoid juncture, with removal of perirectal tissues. In the two-stage operations the pelvic peritoneum was usually opened and closed. In several cases the posterior wall of the vagina was adherent to the growth and removed with it. In others, adhesions to the posterior wall of the uterus were separated, and the uterus then brought down into the defect. In one instance a posterior resection was performed on a woman 4 months' pregnant, with perfectly normal convalescence and no disturbance to the pregnancy.

Multiple infected perineal fistulæ-in-ano have been operated on, the usual type of operation being wide excision and packing. The course of the tracts may be painlessly explored, widely excised, and packed, or closed, as indicated. In such cases infiltration of an infected field would be unwise.

Operations on the genital tract have included excision of carcinomatous ulcers of the vulva, perineorrhaphy, complete vaginectomy, the Bovée operation for cystocele, trachelorrhaphy, dilatation and curettage with insertion of the Baldwin tube, repair of vesicovaginal fistulæ, excision of vaginal tumors, the Watkin's interposition operation, and the Mayo vaginal hysterectomy.

In malignant growths of the vulva, it is best not to rely on circular infiltration, because of the wide extirpation necessary and the possibility of spread of cancerous foci. Transsacral block affords a very wide area of anæsthesia, very efficient in these cases, unless the external anterior parts of the labia majora are to be included in the operative field. In the latter case infiltration from the pubic spines must be practiced (Fig. 2) besides the transsacral block.

Vaginectomy has been performed in relaxed pelvic floors after hysterectomy, in which the pelvic peritoneum was painlessly opened and closed. The Bovée and Clark operations for

Fig. 13. Suprapubic field block. Wheals *a*, *b*, and *c*, mark the sites of injection along the lateral margins of the rectus muscles.

cystocele have been painlessly performed. Multiple perineal operations have been performed on the same patient under the same anæsthesia such as dilatation and curettage, trachelorrhaphy, perineorrhaphy, and hæmorrhoidectomy.

BORDERLINE OF USEFULNESS

It is in the Watkin's interposition operation and the Mayo vaginal hysterectomy that the borderline of usefulness of the transsacral method is reached. In these operations, particularly the hysterectomy, the most difficult problem is the prevention of traction pain. Pulling of the uterus through the vaginal wound usually causes pain from tension on the broad ligaments. Nor can this trouble be remedied by parametric injection of the broad ligaments, since the same amount of tension is still present beyond the area infiltrated, the parametric injections serving only to anæsthetize the uterus itself. In cases of extreme relaxation, and in complete prolapse the anæsthesia is usually sufficient for hysterectomy, and may be followed by perineorrhaphy. In cases in which there is not complete anæsthesia the administration of a first stage ether anæsthesia during the deep manipulations, constitutes a combined method much safer than general narcosis alone.

PARAMETRIC ANÆSTHESIA

Attempts have been made at various times to render the entire uterus insensitive by parametric

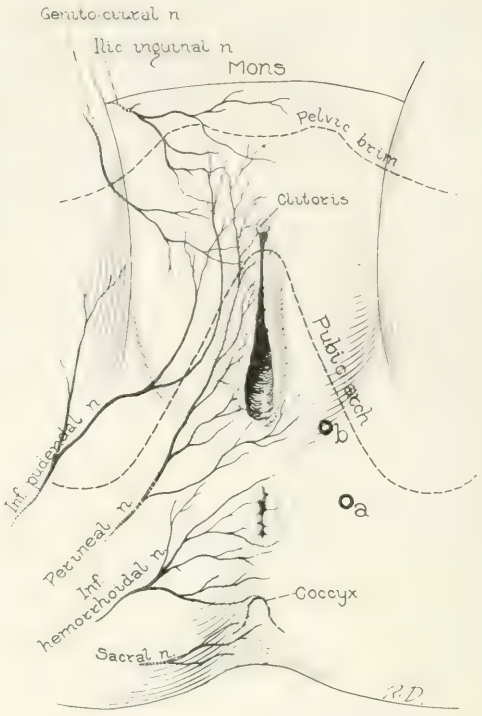

Fig. 14. Injections into perineum after King. Distribution of sensory nerves shown on the right side. On the left side *a*, and *b*, mark sites of puncture for the injections.

injections for such operations as vaginal hysterectomy. Ruge first described a systematic method for these injections. A long needle is inserted from 4 to 5 centimeters into the parametrium to the right and left of the cervix. It is directed slightly to the side in order to block the nerves which enter the parametrium as far as possible from the uterus, to obtain as extensive an anæsthesia of the pelvic floor as possible. In the same manner injections are made from points on the anterior and posterior vaginal vault. Injections are made with very fine needles and always while the needle is in motion. When these precautions are followed it is claimed that most vessels and any coils of intestine with which the needle may come in contact will be pushed aside and not injured.

While this method seems to have given satisfaction in the hands of its originator, it has been but very little employed by other surgeons operating under local anæsthesia. In many women, especially those with tense vaginas, some method of anæsthetizing this part must also be practiced, in order to permit sufficient distention and traction. The deep injections by this method are not

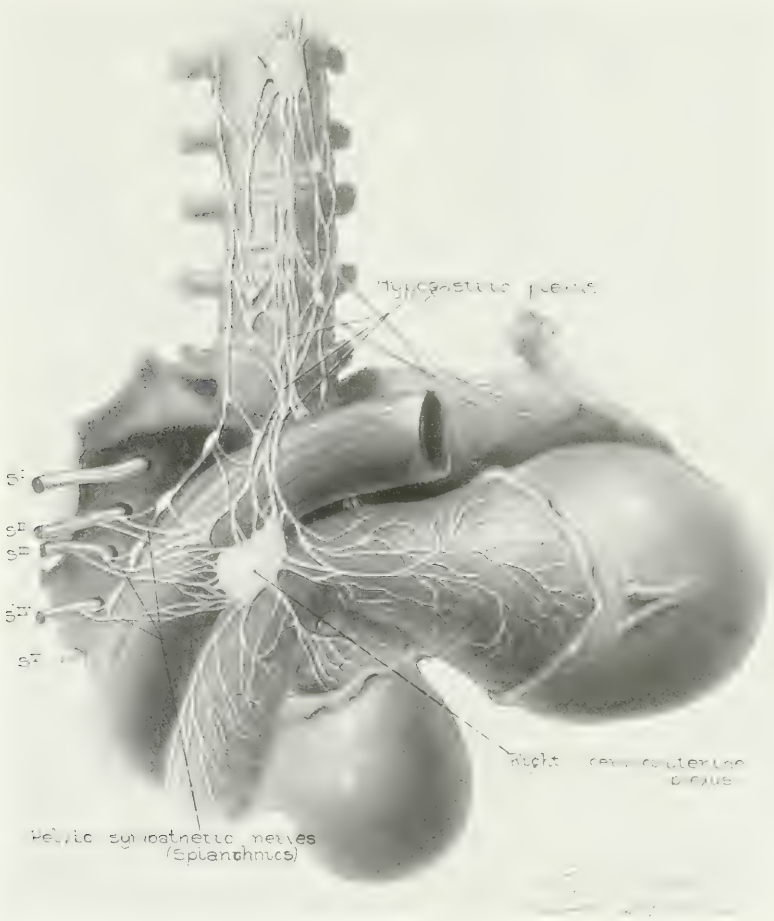

Fig. 15. Innervation of the pelvic organs after Frankenhaeuser.

without an element of danger of perforating rectum, bladder, or coils of intestine, since they are made without any reliable guide. When the normal anatomical relations are distorted by pelvic lesions, this danger is much greater, and septic foci may be punctured and disseminated by the passage of the needle. Even when properly performed, this technique does not avoid the transmission of traction on the uterus to the pelvic peritoneum sufficient to cause pain. For these reasons parametric injections have not become popular for uterine operations.

ABDOMINOPELVIC OPERATIONS

In operating within the abdominal cavity, only a limited number of gynecologic operations are feasible, and only then under very favorable conditions, such as thin relaxed abdominal walls, no acute inflammation or pelvic adhesions, but free mobility of the parts. The abdomen may be opened painlessly in the middle line after infiltration of the skin and subcutaneous tissues, then the aponeurosis, and lastly the preperitoneal tissue which also anæsthetizes the peritoneum. Laparotomy may also be performed under suprapubic field block, which is accomplished by distributing 0.5 per cent solution along the outer margins of the recti muscles in the same planes from the pubes to a little above the umbilicus. Wheals are placed above each pubic spine *a*, Figure 13, then along the outer margins of the rectus abdominalis muscles, *b* and *c*. The deep injections are first made from these wheals by repeated perforations of the aponeurosis at distances of about 1 centimeter and injection of about 2 cubic centimeters of solution. Perfora-

tion of the aponeurosis is easily recognized by the disappearance of the increased resistance offered by this dense layer to the passage of the needle. When these deep injections are completed, subcutaneous fanwise injections are made in the same plane joining the wheals together (Fig. 14). From wheal *b*, a longer needle is then passed obliquely downward toward the middle line and behind the symphysis pubis injecting, as the needle advances, until the space of Retzius is reached. Retractors must be employed with great caution, and extreme gentleness used in handling the viscera. Abdominal peritoneum and viscera being unanæsthetized, no packing of the abdominal cavity can be performed, no breaking up of adhesions nor grasping of the uterus with volsellum or other toothed instruments unless the points at which they are applied have first been infiltrated. The patient should breathe through her mouth in order to relax the abdominal walls. In the Trendelenburg position the bowels have a tendency to drop down toward the diaphragm and away from the operative field, thus affording the maximum of exposure. Certain operations are now possible by the aid of infiltration within the abdomen. Salpingo-oophorectomy may be performed when these parts are free, by infiltrating the broad ligaments and the pelvic and uterine attachments of these parts proximal to the line of incision on the anterior and posterior surfaces. Pedunculated ovarian cysts, when not adherent, may be removed by thorough infiltration of the pedicle. For the more extensive abdominopelvic operations, however, particularly hysterectomy, general narcosis is necessary for the intra-abdominal work. The addition of transsacral nerve block, and even the supplementing of this procedure by lumbar paravertebral nerve block does not solve the problem. Abdominal viscera are still unanæsthetized, and the exposure and traction necessary usually cause intolerable pain. Infiltration around the entire broad ligaments and uterus on the anterior and posterior surfaces, sufficient for hysterectomy, has been accomplished in only a few very favorable cases by men of widest experience in the handling of local anæsthesia problems, the thorough and comprehensive work of Farr constituting the only notable exception to this statement.

For most surgeons of wide experience local anæsthesia by whatever method induced, does not create an operative condition compatible with the employment of the appropriate surgical methods which are indicated in most abdominopelvic operations.

OPERATIONS ON THE BLADDER

Operations on the bladder, however, may be quite satisfactorily performed by suprapubic field block and transsacral nerve block. The problem here is not complicated by intra-abdominal anæsthesia, unless the peritoneum is opened. The suprapubic field block facilitates the use of retractors. The space of Retzius is anæsthetized by the anterior injections, and the block of sacral nerves anæsthetizes the bladder. Resection of malignant growths of the bladder may be performed by the transvesical route, also the excision of diverticula. When the peritoneal cavity is invaded, however, the anæsthesia is usually incomplete.

APPLICABILITY TO OBSTETRICS

The successful employment of sacral nerve block anæsthesia in gynecology, and in fact in operations involving the entire pelvic floor, naturally leads to the question of its practicability in obstetrics. Anæsthesia is as justifiable in obstetrical work as it is in operative gynecology; and in the more difficult cases it is indispensable. The fundamental requirements of an obstetrical anæsthesia, however, are widely different from those in gynecology, hence the anæsthetics and their methods of administration must likewise vary, in order to satisfy the special requirements in this particular field. In the selection of the anæsthetic, the general condition of the mother must first be considered, much as in gynecology. The possible influence of pulmonary, cardiac, and renal lesions, as well as the toxæmias of pregnancy may determine the question of safety to the mother. The second consideration must be the influence of the anæsthetic on the child, and the third, the effect on the powers of labor. The employment of a possible local anæsthesia should adequately fulfill the first and second of these requirements, and if it does not too greatly retard the progress of labor, its use should prove almost ideal. Another feature in anæsthesia in obstetrics, which should facilitate its use, is the fact that an anæsthetic is rarely necessary before the second stage. A cheerful and sympathetic demeanor with the proper encouragement from the physician and attendants will usually suffice throughout the first stage. It is certainly well to delay anæsthesia as long as practicable, and many labors may, of course, be easily conducted without any anæsthesia. With the beginning of the second stage, pain becomes much more intense, and when an anæsthetic is to be resorted to, a few whiffs are given during pains as the head descends. The demand for anæsthesia increases as labor

Fig. 16. Position of parturient woman for block of sacral nerves.

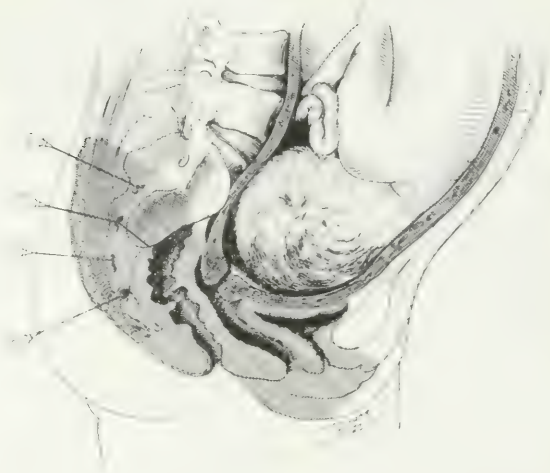

Fig. 17. Median longitudinal section of the pelvis anterior to the sacrum, with entire sacrum preserved. Needles in position for block of the second to fifth sacral nerves by the posterior route.

progresses, although a superficial anæsthesia is usually sufficient until the head passes through the vulva. It is at this point that the most extreme anguish is experienced, so that anæsthesia must be pushed to a true surgical degree, but stopped as soon as the head is born. Two degrees of anæsthesia are thus experienced: first, an anæsthesia in which pain is dulled or relieved with only a brief, or no loss of consciousness; and second, surgical anæsthesia in which consciousness is lost, and body rigidity is overcome.

But little attention has been paid to the application of local anæsthesia of the pelvic floor in obstetrics. In fact, most obstetricians regard local anæsthesia to be of very little value in the analgesias of childbirth. The topical application of cocaine solutions to the cervix produces a limited degree of anæsthesia during the stage of dilatation, not sufficient, however, to justify its employment. Besides the danger of sepsis from intravaginal manipulations, there is a possibility of constitutional toxic manifestations.

INJECTIONS INTO THE PERINEUM

Infiltration into the perineal tissues has also been practiced with but little benefit. Hoag recommends infiltration of the perineal tissues and the employment of nitrous-oxide-oxygen, thus applying the principle of "anociation" to the obstetric field. But scant anæsthesia results from infiltration methods, as regards control of pain during the second stage. While episiotomy and repair may be painlessly performed by this method, the entire pelvic floor must obviously be anæsthetized in order that the distention and tearing of these tissues caused by the escape of the head and shoulders from the vulva may take place painlessly. A somewhat wider area of anæsthesia results by block of the pudic nerve. Two sites of injection have been proposed. Ilmer first recommended block of this nerve on both sides of the medial surfaces of the inferior rami of the os ischii, a procedure since improved by King (Fig. 14). For operative procedures, this method is usually unsatisfactory. No extensive anæsthesia of the pelvic floor results, even though both pudic nerves are blocked at this point. Moreover, anatomical relations make blocking of this nerve a difficult procedure, because it is well covered on the inner surface of the os ischii by the obturator fascia of Allcock's canal, and it divides before its entrance into the ischiorectal fossa. The perineal method suggested by King has been tried by us in a limited number of cases with indifferent results.

The second method of blocking the pudic nerve is at a point farther back on the outer surface of the spine of the ischium. The ischial spine is palpated from in front, by way of the rectum. The needle is then introduced into the soft tissues of the perineum to one side of the rectum, and advanced until contact is taken with the anterior surface of the spine. The direction is then changed backward, and the needle advanced somewhat farther than before, to the outer surface of the spine, at which point the injection is made. Blocking of the pudic nerve by this method has never been widely

attempted because of the technical difficulty and uncertain results. Moreover, its application for the control of pain in the second stage of labor is hindered by the low lying head. Because of this feature the method is even more difficult to employ than in the field of gynecology.

LOCAL ANÆSTHETIC REQUIREMENTS

The most efficient local anæsthetic for obstetrics must be one that will anæsthetize the entire pelvic floor and those structures included within the pelvic girdle. The pain during dilatation of the cervix is not of the same intensity as that suffered by birth of the head through the perineum, and seldom requires anæsthesia of any sort. The suffering caused by the advancing presentation on the perineum is due to the stretching and tearing of the soft parts of the entire pelvic floor, this pain being, therefore, much more severe in primipara than multipara. Anæsthesia by injections into the perineum anæsthetizes only a part of the pelvic floor, so that, while minor surgical procedures on the perineum may be carried out successfully with this method, the extreme stretching tension and tearing of soft parts when the head is being born, must be transmitted beyond the anæsthetized area to a sufficient extent to cause pain. Surgical experience indicates that even when the methods of injecting into the perineum are successful, scant operative anæsthesia results unless the coccygeal plexus, superficial perineal rami, and posterior cutaneous femoral nerves are also blocked.

Block of the sacral nerves before the formation of the plexuses should afford best relief from pains of childbirth, since its use in gynecology has shown that the entire pelvic floor and viscera may be anæsthetized. This method was first employed by epidural injections of novocain by Stockel in 1909. His best results were obtained by the injection of 30 cubic centimeters of 0.5 per cent solution, an amount and strength insufficient for surgical anæsthesia. Among other benefits he claimed to have reduced the severity of the pains and in four cases terminated labor by the application of low forceps.

Schlimpert and Schneider next employed the method in the entire field of gynecology and obstetrics. They used the formula perfected by Lowen and Gros, and repeatedly demonstrated its value in operative and manipulative obstetrical work. As a means of control of the second stage pain in normal birth, they found that the progress of labor was often retarded, so that the child was often born with the usual amount of pain after the anæsthetic effect of the epidural injection had worn off. Following the publication of Schlimpert and Schneider, other obstetricians employed the method, most of whom reported very favorable results. Prominent among these are Ambrosini, Piantoni, Ferreyra, de Kervily, Perrill, and Schellekens. In view of the valuable results reported by these men, it is strange that so little attention has been given to this method by American obstetricians. The disadvantages are largely those which obtain in gynecology, namely, the small percentage of failures, variable height of anæsthesia in successful cases and occasional toxic manifestations. These disadvantages have been overcome by the transsacral method plus a low epidural injection, although there is no record of this method ever having been employed in obstetrics. Even those surgeons who have employed local anæsthesia most widely neglect to attempt it in labor. Allen makes but scant mention of the method, while Labat entirely ignores the possibilities of nerve block anæsthesia in obstetrics.

Anatomy and physiology. For an understanding of the effect of sacral nerve block on the pelvic floor, and powers of labor, a consideration of the nerve supply is valuable. The innervation of the pelvic floor is supplied by the second, third, fourth, and fifth sacral nerves and anococcygeal filaments passing out directly through the sacral hiatus. The first pair of sacral nerves does not take part in the innervation of the pelvic floor proper, except possibly a contribution to sensory innervation of pelvic peritoneum, but distributes principally to the lower extremities and buttocks. Sacral sympathetic efferent fibers leave the spinal cord with the anterior roots of the second, third, and fourth sacral nerves (Fig. 15). These fibers are collected in the pelvis into the nervi erigentes, or pelvic nerves, which proceed to the pelvic sympathetic plexuses from which fibers are distributed to the pelvic viscera. Vasodilators are distributed to these organs, while inhibitory fibers probably pass to the smooth musculature. Afferent sympathetic fibers also conduct impulses from the pelvic viscera to the second, third, and fourth sacral nerves.

The nerve supply of the uterus is derived partly from the cerebrospinal and partly from the sympathetic. The cerebrospinal is represented mainly by the third and fourth sacral nerves, principally sensory. More important is the sympathetic nerve supply. A large plexus is located on either side of the cervix, which is composed of branches from the sacral sympathetics and the hypogastric plexuses. Large plexuses of nerve filaments pass down on either side of the rectum,

and following the course of the uterosacral ligaments, terminate in the cervical plexuses.

Little is known of the nervous mechanism of labor contractions. A nerve center is believed to exist in the cortex, one in the medulla, one in the cerebellum, and one in the lumbar enlargement of the cord, because irritation at these points causes uterine contractions. Delivery has been shown to occur in animals when the nerves connecting the uterus to the central nervous system have been severed. The primary stimulus for uterine contractions is, therefore, in the uterus itself, although under normal conditions the contractions of this organ are doubtless considerably influenced by reflex effects through its extrinsic nerve supply, and probably also by substances brought to the uterus by the circulating blood, or originating in the fetus itself.

On the basis of anatomical and physiological reasons, block of the second, third, fourth, and fifth sacral and the anococcygeal nerves should have the following effect when employed in the second stage, or latter part of the second stage of labor.

1. Block of spinal afferent sensory fibers should result in a loss of sensation of the structures of the pelvic floor.

2. Block of spinal efferent motor fibers should abolish any spasm of the pelvic floor musculature, resulting in complete relaxation.

3. Block of sympathetics distributing to the uterine musculature and vessel walls, by abolishing vasodilator and inhibitory impulses, should produce contraction of the smooth musculature and blood vessels of the uterus. The sacral sympathetics make up but a small part of the sympathetic innervation of the uterus, however, so that the effect of block of the sacral sympathetics alone would be difficult to foretell.

SERIES OF OBSTETRIC CASES

Observations were made on 90 patients in the obstetrical wards of the Cook County Hospital in Chicago.[1] The comparative merits of the various methods of approach to sacral nerves were studied, and the values of the various formulas for epidural injections were determined. No preliminary hypodermic narcosis was employed, so that whatever alleviation of pain might result could be due to the nerve block anæsthesia alone. Special care was exercised in observations as to duration of anæsthesia and the effect on the progress of labor. The value as an anæsthetic was determined from two standpoints; for obstetric operations, and as a means of abolishing the pain of normal labor.

Methods employed. Transsacral block of the lower four sacral nerves with a low epidural injection was the first procedure attempted. For obstetrical work the patient cannot be placed in the usual ventral decubitus position, but the injections must be made while she is on her side in a modified Sims position (Fig. 16). The patient is instructed to arch her back and bring her knees upward toward her chin as much as possible, which stretches the soft tissues overlying the bony prominences of the sacrum, making them more easily palpable. In this position the sacrum is displaced upward, while overlying soft tissues by their own weight hang lower in relation to the bony framework. The fall of the buttocks displaces the gluteal cleft at least 1 centimeter lower than the sacral hiatus. A nickeloid spinal puncture needle is the best for the epidural injection, as it will bend readily and not break. There is danger of breaking a brittle steel needle in the sacral canal, as it is impossible for most patients to remain entirely quiet during a severe labor pain, while a few will not co-operate at all, tossing about in bed until the pain ceases.

In the first series of 16 patients anæsthetized by this method during delivery, from 60 to 85 cubic centimeters of 1 per cent procaine in half physiologic salt solution was employed (Formula 1). Ten minims of adrenalin to 100 cubic centimeters of solution was employed in all cases. The average duration of anæsthesia was 2 hours and 24 minutes, as determined by testing cutaneous sensation of the perineum with a clamp, a somewhat shorter period of anæsthesia than was thought to be available from our experiences in general surgery. In an attempt to prolong the period of anæsthesia sodium bicarbonate was added to the solution.

The second series of cases was anæsthetized by the same procedure as the first, except that 0.4 per cent sodium bicarbonate was added (Formula 2). Seventeen patients were anæsthetized in this series, using the same quantities as in the first series of cases. The average duration of anæsthesia here was 2 hours and 2 minutes, showing no advantage gained by the addition of sodium bicarbonate.

These two series of cases serve also to emphasize certain difficulties in the induction of transsacral nerve block in parturient women. The lateral recumbent position produces a distortion of normal landmarks often necessitating prolonged

[1] The authors wish to thank Drs. D. E. Hillis, H. F. Lewis, and W. G. Lee for permission to perform this work on the patients of their services, and Dr. Karl A. Meyer and Mr. Michael Zimmer for affording them the use of the hospital facilities.

TABLE I.—QUALITY OF ANÆSTHESIA RESULTING FROM DIFFERENT METHODS

	Complete pelvic floor anæsthesia	Partial pelvic floor anæsthesia	Average duration in successful cases	Failure	Cases in which labor outlasted anæsthesia	Cases re-injected
Formula 1 Transsacral method	15	1	2 hours, 24 minutes		4	
Formula 2 Transsacral method	17		2 hours, 2 minutes		4	4
Formula 3 Epidural injection	10	3	1 hour, 57 minutes		4	4
Formula 4 Epidural injection	9	3	1 hour, 55 minutes		1	1
Formula 5 Epidural injection	12		2 hours, 10 minutes	1	4	4
Formula 6 Epidural injection	9	1	2 hours, 7 minutes		1	

search before the foramina are located. Foramina are much more difficult to locate in the obese patient. Not only is the distance from the skin surface to the sacrum greater, which will of itself multiply the number of attempts necessary to locate the foramina, but it is more difficult to recognize bony landmarks. The pad of fat over the sacrum, normally more prominent in women than in men, seems to be increased in pregnancy. Often it was impossible to palpate the posterior superior spine of the ilium. For this reason some surgeons regard obesity as a contra-indication to the use of the transsacral method (Fig. 17). When, besides obesity, the parturient will not co-operate, but twists and squirms about in bed during a labor pain, transsacral nerve block becomes a tedious and aggravating procedure both to the patient and operator. Because of this difficulty, sacral nerves were next blocked by epidural injections.

The third series of 22 patients were given from 40 to 50 cubic centimeters of 1.5 per cent procaine-adrenalin solution in 0.4 per cent sodium chloride and 0.4 per cent sodium bicarbonate (Formula 3). The fourth series of 12 patients received from 25 to 35 cubic centimeters of a 2 per cent procaine-adrenalin solution with 0.4 per cent sodium bicarbonate (Formula 4). A fifth series of 12 patients was given from 40 to 50 cubic centimeters of 1.5 per cent procaine-adrenalin solution as in the third series, except that no sodium bicarbonate was employed (Formula 5). The sixth series of 10 patients were anæsthetized with a preparation of procaine and suprarenin in ampules. The ampule contains 1 gram of procain and 0.00055 gram suprarenin in 5 cubic centimeters distilled water.[1] (Formula 6). The content of this ampule added to 60 cubic centimeters of distilled water gives a soluton of 1.5 per cent strength, as in Formula 5. Two or three drops of adrenalin are added to this before use, as the normal suprarenin content is small. The advantage of such a preparation is only one of convenience in making up the solution, and in having a preparation known to be fresh.

In obtaining data as to the duration and height of anæsthesia, cutaneous sensation over the perineum was tested by means of a needle or artery forceps. Even after delivery, the patient in most cases remained in the delivery room until sensation returned. It was necessary to rely to some extent on the patient's impressions of the amount of pain experienced. This method is often inaccurate, and when utilized was obtained only during the course of an ordinary conversation, not by leading questions. Not infrequently little or no help regarding subjective sensations was obtained because of the low mentality of the patient, or her inability to cerebrate well because of fright or excitability. In such instances, and as much as possible with all patients, a careful study of behavior before and after injections was the only means of obtaining data (Table I).

It may be noted in Table I that more constant results were obtained over a longer time by the transsacral method, and that there is no advantage to be gained by the addition of sodium bicarbonate in either the transsacral or epidural methods. The difficulties in execution of transsacral nerve block already mentioned make the epidural the more practical, even though accompanied by a certain low percentage of failures and a variation in the height of anæsthesia, which we believe is due mainly to faulty technique.

Clinical course. Shortly after the injection into the sacral canal has begun, the parturient often complains of a cramping sensation or paræsthesias in the legs; this can be taken as an indication that the needle is correctly inserted. Usually within 5 minutes, depending on the rapidity with which the injections are made, a marked change in the patient's behavior is noted. The patient who previously was restless and fretful even between pains, becomes quiet during the interval, and there is not the usual

[1] These ampules were furnished through the courtesy of the H. A. Metz Laboratories.

noisy outcry. In the next few minutes, usually by the time the injection is completed, the patient becomes restful and ceases to complain at all. A rectal examination made within 5 minutes after the needle has been withdrawn reveals a marked relaxation and dilatation of the anus, as a rule, so much so that two or three digits can easily be inserted painlessly. The vaginal orifice soon begins to relax and, if a manual examination is made, the introitus will be noticeably larger. In a few instances a vagina normally admitting two fingers with difficulty, after injection admitted the whole hand. The perineum formerly firm and unyielding is now relaxed, and the levator ani is palpated with more difficulty than when normally tonic. Not long after relaxation is noted, cutaneous anæsthesia of the perineum and vulva slowly appear. In 10 to 15 minutes, the perineum is insensitive to pricking or pinching, although pressure can be identified in some cases as can traction on the skin. However, in most cases sensation of all kinds is entirely abolished.

After 2 hours the perineum usually begins to lose its anæsthesia, but sensation rarely becomes acute until after 2½ hours or more. The first change noticeable is that traction on the skin of the perineum elicits pain. Next pinching will be felt, and finally the patient will be able to distinguish between the head and point of a pin. If the child is not born during the period of anæsthesia, the pain associated with the uterine contractions gradually reappears and after from 2 to 2½ hours, the patient again begins to toss about and suffer the usual pain of labor. Relaxation is the last to disappear, often being manifest more or less for 4 or 5 hours.

The height of anæsthesia by the epidural method varied considerably. Not infrequently numbness, paresis, and paralysis of the lower extremities occurred. In a few cases this numbness continued up over the abdomen, in rare cases as high as the costal margins, giving the high sacral anæsthesia of Schlimpert and Schneider. As a rule, however, patients stated that there was numbness in the sacral region, perineum and medial surfaces of the thighs. When the transsacral method was used there was only slight involvement of the lower extremities. Usually there was numbness along the medial surfaces of the thighs, but in no case did paralysis occur. When epidural injections of 30 cubic centimeters of Formula 4 were given, involvement of the lower extremities and abdomen was more common. These manifestations were apparently in direct proportion to the size of the dose, and definitely to the rapidity with which the solutions were injected. This may possibly be explained on the basis of increased pressure forcing the anæsthetic solution higher up the extradural space, rather than permitting diffusion throughout the tissues of the sacral canal.

In the epidural method the left leg was affected more often than the right, and when both were affected, the left more markedly. In a few instances the zone of anæsthesia over the genitalia extended higher on the left side than on the right. This asymmetry was undoubtedly the result of gravity, the fluid diffusing higher on the side on which the patient lay. Paralysis of the anal sphincter was usually complete, and a word of caution is not amiss regarding the administration of enemata. They should always be given before anæsthesia is induced, for afterward there is no efficient control of the anus until the anæsthetic action has worn off. In no instance was there any loss of bladder control.

Complications. Careful watch was kept for any complications or after-effects due to the anæsthetic, and we were well pleased to observe so few. Rapid pulse and palpitation were commonly observed, the acceleration usually amounting to not more than twenty beats for each minute. This was more marked in patients exhibiting a strumous enlargement without other symptoms. In a few instances, during the injection, there was marked acceleration of the pulse, in one instance reaching 180 for a short time accompanying this was a complaint of vertigo, a feeling of faintness and precordial distress, pallor of the face, increased respiration and occasionally cold extremities. These symptoms were most always manifested during the early course of the injection and lasted but a few minutes. The injection should be stopped in such instances, then resumed slowly; the symptoms of reaction will clear up without the need of treatment. In our cases the possibility of hyperthyroidism was not ruled out, so that some of the reactions were doubtless due to hypersensitiveness to adrenalin. In no instance did a reaction last more than 10 minutes, save for a mild acceleration of the pulse.

After-effects. After-effects were few and of no consequence. Headache, which is a common sequela of spinal anæsthesia, could in no instance be linked with the anæsthetic. The incidence of headache on the day following delivery was no greater than that which occurs normally. In a few cases soreness over the sacrum was complained of for 3 or 4 days. Local tenderness was superficial at the site of injection and did not involve the bone. It was more common with the

TABLE II.—PRESENTATION, POSITION, AND OPERATIVE PROCEDURES

	Primipara	Multipara	Occipito-anterior	Persistent occipito-posterior	Breech	Face	Transverse	Operative delivery								
								Forceps			Decapitation	Version	Insertion of bag	Manual dilatation of cervix	Episiotomy‡	Lacerations†
								Low	Middle	High						
Formula 1 Transsacral method	10	6	14	1	1			2							2	5
Formula 2 Transsacral method	10	7	13	4					3					1	1	5
Formula 3 Epidural injection	13	9	15	3	3	1	1	2	3		1	2			2	4
Formula 4 Epidural injection	6	6	10	1		1		1		1					1	2
Formula 5 Epidural injection	6	7	11	2				3	2							3
Formula 6 Epidural injection	9	1	7*	2	2*			2		2		1	1	2		2
Total	54	36	70	13	6	2	1	10	5	3	1	3	1	3	6	21

†Under lacerations are included tears requiring stitches.
‡Episiotomy was not performed unless it was apparent that severe gross perineal injury was inevitable.
*Twin birth, occipito-anterior and breech.

transsacral method, or when epidural injections were repeated. This was a minor complaint, however, always clearing up within a few days without any special care.

Two patients complained of numbness of the legs, one for 3 days, and the other for 4 days. These symptoms were quickly overcome. One patient gave us concern for a few days. She complained of cold feet, pain in the back, and incontinence of urine. A low-grade temperature and a moderately accelerated pulse rate developed. Examination of a specimen of catheterized urine revealed large numbers of pus cells, and after a urinary antiseptic was given for a few days, all symptoms and findings disappeared.

It is our opinion that the procedure is relatively harmless. When compared with the after-effects of a general anæsthetic, such as ether, it has fewer disadvantages, and in addition may be used in cases in which a general anæsthetic is contra-indicated. The persistent nausea and vomiting associated with a general anæsthetic is entirely avoided.

NINETY OBSTETRIC CASES

The 90 cases comprising this study were not selected, as will be noted from the accompanying tabulations. The total number of patients delivered during this study was 162. Patients not receiving injections were missed either because they came in too late for an injection or were delivered in our absence. Fifty-four of the 90 patients were primiparæ, a percentage higher than the general average of this institution, which is about 45 per cent. This increase is due undoubtedly to the fact that the rapidity of delivery in multiparæ made it difficult to determine when to inject them, and many were delivered before they could be injected. Multiparæ were also more often admitted to the hospital just in time to be delivered.

In this series there was a considerable number of prolonged first-stage labors. There are two factors to account for this. First, because few of the parturients were seen until well advanced in labor, the only method of estimating the onset was by questioning, a method at best unreliable. Second, many of these long labors occurred in occiput posterior positions in which the use of sedatives or opiates was avoided in order not to introduce any complicating factors. The result was an increase in the incidence of secondary inertia, and undoubtedly some of the forceps deliveries could have been avoided if rest periods had been given. Such facts must be considered in an analysis of these cases from the standpoint of the incidence of the use of forceps and of inertia. In two instances the second stage was allowed to prolong itself for an unusual length of time in order to determine whether the anæsthetic was the cause of the inertia; in neither case could it be attributed to the anæsthetic.

Fifty-one per cent of the patients were colored women, which is about the normal percentage for this hospital. The large number of colored patients naturally increases the frequency of prolonged labor due to contracted pelves. The average weight of the newborn was 7 pounds, as compared with 7 pounds and 3 ounces, the average weight in the cases delivered without the injections. The slight difference may be accounted for by the higher percentage of primiparæ in the series. The high incidence of colored patients also lowers the average weight somewhat.

VALUE IN OPERATIVE OBSTETRICS

It is obvious that all the operations and manipulations in which the operative field lies within the area innervated by sacral nerves can be painlessly performed under sacral nerve block anæsthesia (Table II). Its use in this field possesses many distinct advantages. The unmistakable relaxation of the pelvic floor facilitates any operation attempted by way of the genital tract.

Twenty-one forceps operations were performed, of which ten were low forceps, eight mid-forceps, and three high forceps deliveries. In only three instances was any other anæsthetic employed. Ether was given to one of the patients for psychic reasons only, only enough being given to keep the patient mentally confused. In another instance the patient was given a general anæsthetic before the possibilities of block anæsthesia in this type of work were appreciated. This forceps operation could undoubtedly have been performed without the use of a general anæsthetic. In the third case, general anæsthesia was necessary because the nerve block anæsthesia began to wear off before the forceps delivery was complete. Ether was used in the decapitation operation for the same reason.

The advantages of sacral nerve block anæsthesia in forceps operations are numerous. One can obtain the maximum of perineal relaxation, which facilitates the process of applying the blades, and therefore shortens the duration of the operation and reduces the number of perineal tears. The patient continues to have good uterine contractions unless operated upon immediately after the injections, and the operator not only can apply traction during each contraction of the uterus, but can also induce the patient to co-operate by bringing her abdominal muscles into action. Another strong argument for this method is the absence of harm to the baby from the anæsthetic. In difficult forceps cases, the operator is often hurried because of the danger of anæsthetizing the child. But by this method no worry need be felt so far as the anæsthesia is concerned, and it is not necessary to hurry, with consequent danger of injury to maternal parts.

So far as the mother is concerned, the operation is painless. Occasionally the patient feels pressure as the head is born, but no true pain. The patient's attention is usually engaged by conversation with an assistant who also sponges the patient's face, administers small sips of water, or in other ways obtains control of her attention, and instructs her to bear down as desired. Many of the operations were done immediately after injection, a few at the end of 2 hours, and one after 3 hours. In three instances the Scanzonian manœuvre was performed for persistent occiput posterior positions. In other instances the head was delivered posteriorly, because the relaxation was such that it was deemed unnecessary to rotate. The three high forceps operations were performed very slowly, one taking an hour, and it was exceedingly satisfactory not to be worried about the possible effects of ether on the baby.

There is little difficulty in formulating an opinion with regard to the advisability of using sacral anæsthesia in forceps operations, for there is only one real disadvantage to be considered. In cases in which the indication for operation is fetal exhaustion, the sacral procedure might be too slow. Other than that, the only arguments against its use are those that apply in general surgery, principally the factor of consciousness, which many surgeons demand shall be abolished before beginning any operation of magnitude.

The operation of version and extraction may also be painlessly performed, the relaxation of the pelvic floor being advantageous for this operation. The indications for this procedure were very few in our series, being performed only three times. In such cases it was necessary to obtain the co-operation of the patient in relaxation of the abdominal walls, and too much pressure on the abdomen may result in pain. Some may question the advisability of using this anæsthesia for version, but when it is understood that for a few minutes immediately following the injection the uterine contractions are greatly diminished and not infrequently stopped, so far as can be determined by palpation, this objection carries less weight. In the three instances in which version and extraction were performed, the version was performed immediately after the injection, the patients having been prepared for operation before the injections were made. In this way the turning could be done while the uterus was more or less atonic, and in each case no difficulty was experienced because of the contracting organ. In two cases this measure was used to quiet the uterus until instruments could be made ready for operation. One was a patient having terrific uterine contractions, with the cervix not completely dilated, and the head in the middle pelvic position. Because of a small pelvis and a history of a previous cæsarean section, a middle forceps operation was performed following manual dilatation of the cervix. The other case was that of a neglected transverse, with violent uterine contractions and membranes long since ruptured. Following injection, the uterus became quiet for a few moments until preparations for a decapitation could be made.

Breech presentations can be admirably handled by this method of anæsthesia, for the relaxation of the perineum not only shortens the birth of the breech because of diminished muscular resistance, but facilitates the manipulations so often necessary to deliver the arms and aftercoming head. Relaxation was so great in the six breech cases in this series as well as in the extractions following

the three versions, that episiotomy, so often necessary in these cases, was not performed. One case was particularly worthy of more detail. A first born baby, 9 pounds and 8 ounces in weight, was delivered without the least necessity of an episiotomy, and no demonstrable laceration of the vaginal mucosa or perineum could be found.

Repair of perineal tears was painlessly performed eighteen times, and of cervical tears once. Episiotomy and repair were painlessly performed five times. The anæsthesia has also been used in removing uterine contents in incomplete abortions, in inserting the Voorhees bag and in uterine packs, in patients not included in this list. We were anxious to try the method in vaginal hysterotomy, but the opportunity was lacking.

It was hoped in the beginning that, in cases of rigid cervices, this anæsthesia might relax the cervix and thus shorten the duration of labor. To reach definite conclusions regarding such an occurrence was extremely difficult, as there were so many factors to be considered. Many cases were studied with reference to softening of the cervix, and the injection was given in several instances with this object in mind. Certain patients were definitely improved following injections, but a few were not improved. A conservative opinion is that, in the treatment of a rigid cervix, this procedure cannot be depended on, and we would hesitate to advise its use for that alone. The few cases in which it was combined with scopolamine and morphine showed more favorable results, but it is not impossible that the latter is the chief factor. Further studies should be conducted on this point before a definite statement is made.

In one case, because of a delay during the first stage of labor, evidently caused by a rigid cervix, it was decided to dilate the cervix manually and do a version and extraction in order to expedite delivery, as the patient was a primipara in poor general condition due to a nephritic toxæmia. The cervix, at the time the operation was begun was dilated sufficiently barely to admit the tips of two fingers. Manual dilatation was performed easily and slowly. In two other instances manual dilatation preparatory to operative interference was done with marked ease. The evidence in these cases seems to speak for a partial relaxation of the cervix following injection. The intense pain usually associated with dilatation of the cervix was absolutely wanting.

VALUE IN NORMAL DELIVERY

The value of this means of anæsthesia in spontaneous delivery will, of course, depend on its influence on the progress of labor. Whenever a method of relieving the pains of labor retards or stops the progress of birth, it must be employed with caution. This drawback will obtain to a certain degree with all methods of anæsthesia, because there is usually a direct relation between the amount of pain in labor and the rapidity of progress. In the early course of labor, the pains are the result of the uterine contractions, first in effacing, then in dilating the cervical canal. Later, pain is produced by the distention of the pelvic floor, causing the act of bearing down. The parturient bears down the harder as the pains increase in intensity, finally causing the act of bearing down to become entirely involuntary. Pain, therefore, normally serves as the regulating mechanism for the necessary increase in the intensity of the expulsive powers. If this influence is not experienced throughout the course of labor, it must be compensated for by other means. This fact was not realized in our earlier cases, several of which were allowed to procrastinate until the anæsthesia had subsided. Much better progress was noted after we began instructing the patient how to bear down, and urging her to greater voluntary effort during the uterine contractions. In the absence of proper instruction and encouragement, the parturient is likely to rest and delay the progress of birth until the pains are again felt. It is, therefore, paramount that the continual attendance and encouragement on the part of the obstetrician or attendants be maintained at this juncture.

In the majority of the patients receiving epidural injections and in a few injected by the transsacral method there was nearly complete cessation of the uterine contractions within 10 minutes after the operation was completed. This was also more complete and probably somewhat prolonged in patients receiving the sodium bicarbonate solution. This diminution rarely lasted more than 20 minutes, after which the contractions gradually increased in frequency and duration until shortly the contractions proceeded normally. Unless the abdomen was palpated, however, one would not know whether the contractions were continuing or not. This has not infrequently led the casual observer, as well as the patient, to believe that labor has ceased. Because of the comparatively sudden transition from a condition of extreme anguish to one of ease, there was a tendency to rest or doze in comfort. Feeling no pain, it was difficult for the patients to appreciate the fact that they were in labor, and to realize the necessity of voluntary bearing down in order that labor might progress.

TABLE III.—DURATION OF LABOR AND WEIGHTS OF INFANTS

	Average duration of labor						Weight of infants in grams		
	First stage		Second stage		Third stage				
	Primipara†	Multipara	Primipara	Multipara	Primipara	Multipara	Average	Low	High
Formula 1 Transsacral method	18 hours	8 hours 8 minutes	1 hour 24 minutes	52 minutes	13 minutes	11 minutes	3480	2400	4560
Formula 2 Transsacral method	21 hours 45 minutes	9 hours 42 minutes	1 hour 45 minutes	48 minutes	12 minutes	16 minutes	3750	2760	4440
Formula 3 Epidural injection	13 hours 30 minutes	7 hours 35 minutes	2 hours 35 minutes	48 minutes	10 minutes	12 minutes	3360	1980	4290
Formula 4 Epidural injection	25 hours	10 hours 20 minutes	1 hour 30 minutes	50 minutes	11 minutes	12 minutes	3330	2310	4320
Formula 5 Epidural injection	13 hours 25 minutes	14 hours 24 minutes	2 hours	43 minutes	15 minutes	9 minutes	3330	2490	4185
Formula 6 Epidural injection	19 hours 24 minutes	3 hours*	2 hours 12 minutes	45 minutes	18 minutes	15 minutes	3000	2220	3840

†The first stage durations are not very reliable since they were estimated in most cases from the patients' statements which are often far from reliable. Another factor increasing the duration of the first stage is the high incidence of pathological lesions which is usual at charity hospitals.
*1 multipara only in this series.

This is undoubtedly what occurred in the observations of Schlimpert and Schneider. A few continued to have abdominal pain of colic-like type and a few a feeling of tension in the region of the broad ligaments during contractions, but such pain is usually of a mild nature. In two instances the presenting head definitely retreated following injection. The only explanation we can offer is that the pelves of these patients were moderately funnel-shaped and that during the preliminary diminution in contractions the passengers slipped back. In both instances the anæsthesia was given early in labor.

The feature of greatest difficulty is in the selection of the proper time to induce anæsthesia. There was a tendency to apply it too early in primiparæ and too late in multiparæ. At first a considerable number received injections too early to obtain the benefits of the anæsthesia during the actual expulsion, because of our mistaken impressions about the duration of anæsthesia. In many cases, also, the time of delivery could not be accurately foretold. However, it was soon found that the injections could be repeated without apparent danger, so that a second, and in three cases a third injection, was given when there had been little or no reaction from the first one. Yet we feel that the injections should not be unnecessarily repeated. Ability to judge the proper time for injection is absolutely essential if the best results are to be obtained, hence the necessity of having the patient under close surveillance and of having knowledge of position, dilatation, station, and progress. Any abnormalities that may retard the normal progress must be taken into consideration when estimating the proper time for anæsthesia. The duration of anæsthesia in our cases averaged only 2 to 2½ hours, so that the problem is to select the time which lies within the last 2-hour period, including the termination of labor. If it could be determined with certainty that labor would terminate within an hour, the problem of sacral nerve block anæsthesia would be much more easily solved. At first, injections were given when the dilatation of the external os was 4 or 5 centimeters and the head at or below the ischial spines in primiparæ. Multiparæ were injected at about the same time. Later it was decided that the best time for primiparæ was at a somewhat later period, when the os had reached at least 7 centimeter dilatation, and in multiparæ when the dilatation was at least 4 centimeters for average cases.

When, as a result of good co-operation on the part of the patient, labor terminates during the period of anæsthesia, it will be without the usual outcry, and often the patient will not believe the baby has been born until it is shown to her. Other patients feel dull pressure as the head slips over the perineum. The perineum slides back readily from the head in most instances with such ease that often the obstetrician is surprised, because a tear seems inevitable. In a few in-

stances an episiotomy was performed because of marked narrowness of the introitus. Following delivery, no tendency to atonicity of the uterus was noticed. The placenta separated normally, and there was no tendency toward hæmorrhage, so far as could be estimated grossly. In fact there was less blood lost and less atonicity than when ether was administered at the completion of the second stage. Involution of the uterus occurred normally, and late postpartum hæmorrhage did not develop. In none of the cases was there any alarming hæmorrhage following expulsion of the placenta.

The fact that the parturient did not lose consciousness enabled her to appreciate the progress of labor, step by step, until termination occurred. Under these conditions, the opinion of the patient was of great value and it was within the power of the obstetrician and others to impress her with the advantage of this procedure. Most patients who had experienced previous labors without anæsthesia expressed profound appreciation of the freedom from pain of the present method. Not infrequently, after the study had been well started patients came to the delivery rooms with the request that the injections be given them, as they had heard how easy it was to have babies by this method of anæsthesia. We had no difficulty in obtaining the consent of the patient, and particularly when it was desired to repeat the injection. One of the investigators was accosted one day by the occupant of an apartment over the maternity department with the question, "Aren't you having any deliveries down stairs anymore?" This emphasizes the infrequency of the usual noises emanating from the delivery room. This feature was frequently remarked on by the nurses in attendance, and lately one of us has received a communication from that department of the hospital stating that the noise and commotion following the completion of this study was not only much more noticeable, but annoying.

DISCUSSION

While the period of most extreme anguish in spontaneous delivery may be controlled by present methods of block anæsthesia, the field of usefulness will greatly increase when a means has been devised to prolong the action of an epidural injection. Of the many methods devised to potentiate local anæsthetic solutions, the addition of sodium bicarbonate had been given widest publicity, and this method in our hands was of no value at all. Other chemicals have been used, such as calcium chloride, and potassium sulphate. Clinical experience, however, indicates that the potentiation attributed to these drugs is greatly overestimated. Allen suggests the addition of 5 per cent gelatin to the solution to delay absorption from the point of injection and thus increase its efficiency. This method would seem to possess advantages and should be given a thorough trial in obstetrics.

Of all local anæsthetic substances, the duration of anæsthesia is longest with quinine and urea hydrochloride solutions. Anæsthesia may last from several hours to 5 or 6 days in infiltration anæsthesia. The injection of a solution stronger than 0.25 per cent produces a marked induration of tissues which may end in sloughing. This induration is due principally to a fibrinous exudate, indicating a local irritant action on tissues. For this reason its use has been largely abandoned in infiltration anæsthesia, and it was never popular for nerve trunk anæsthesia. No record of its use in epidural injections is available, but because of the local tissue disturbance within the sacral canal that a solution of sufficient strength to block sacral nerves would most likely produce, its use here is not to be recommended. A small amount of this drug, 0.1 to 0.2 per cent, is still occasionally added to other local anæsthetic solutions for the purpose of prolonging the anæsthesia. This strength might prove harmless in the sacral canal when added to the usual novocaine formula, and of real advantage in prolonging the duration of anæsthesia.

Further investigation should be made of the whole subject of epidural injections as applied to obstetrics. It is possible that the drugs are already at hand which, by their proper combination and use, will produce a perfectly safe local anæsthesia of the entire pelvic floor and viscera for 5 or 6 hours without repetition. Such a procedure should find immediate widespread use in obstetrics and prove to be the anæsthetic of choice in normal delivery.

SUMMARY

Special care should be exercised in utilizing every possible detail contributing to the physical comfort and mental ease of women while on the operating table. Such precautions are especially valuable with regard to the lithotomy position, which is at best uncomfortable, sometimes exceeding the limit of tolerance in obese women.

The preliminary administration of pantopon and scopolamine in proper amount contributes in establishing favorable conditions, but the stage of twilight sleep should not be reached.

The more superficial operations on the vulva, perineum, and anus may be quite satisfactorily

performed under terminal infiltration. Such operations include the removal of cysts and solid benign tumors of the labia majora and minora, superficial fistulæ, perineorrhaphy, surgery of the terminal rectum, and the removal of cervical polypi.

The foregoing operations may be painlessly performed in by far the greater number of cases by block of the sacral nerves by injection of an anæsthetic medium into the sacral canal, called epidural, sacral, extradural, and caudal anæsthesia. If one who uses this method is willing to supplement the failures by local infiltration, it does not work so much of a hardship. The height of anæsthesia by this method is variable, although in a majority of cases anæsthesia of the entire pelvic floor and viscera is produced. Its chief use, in addition to the more superficial operations on the external genitalia, perineum, and terminal rectum, is in dilatation and curettage and in urologic manipulative work.

For the deeper operations on the pelvic floor and viscera the local anæsthetic procedure of choice is the association of a low epidural injection with transsacral block of the upper four sacral nerves. This procedure gives a uniformly satisfactory anæsthesia in surgery of the pelvic floor and viscera by the perineal route. It has been found sufficient for posterior resections of the carcinomatous rectum, both the single and second stage resections, the posterior wall of the vagina often being removed with the growth. Excision of multiple perineal fistulæ and malignant growths of the vulva and vagina, perineorrphaphy, anterior colporrhaphy, repair of vesicovaginal and rectovaginal fistulæ vaginectomy, amputation of the cervix, the Watkin's interposition operation, vaginal hysterectomy, and excision of the carcinomatous urethra, have been painlessly performed under this anæsthesia. Resection of the bladder may be painlessly performed when field block is added for the suprapubic incision.

The borderline of usefulness of the transsacral method is seen in the posterior resection of a high lying carcinoma of the rectum, or rectosigmoid, the Watkins interposition operation, and the Mayo vaginal hysterectomy. Here the traction necessary in delivering the viscus into the operative field is often transmitted outside of the anæsthetized area and produces pain. This traction pain cannot be controlled by paravertebral nerve block, but, when it is necessary, a short primary ether narcosis, or nitrous-oxide-oxygen analgesia should be administered at this point.

Parametric injections do not efficiently control the traction pain of surgical manipulation in vaginal hysterectomy, and anæsthesia of the vagina, also, is usually necessary.

Local anæsthesia in pelvic operations by the abdominal route is sufficient for the laparotomy, but general narcosis is usually necessary for the pelvic work. For most surgeons of wide experience, local anæsthesia, by whatever method induced, does not create an operative condition compatible with the employment of the surgical methods indicated by most pathologic conditions of the pelvis.

In obstetrics the epidural method is more practical than the transsacral, although block of the lower four sacral nerves by the latter technic with the aid of a low epidural injection, gives satisfactory anæsthesia. A great advantage of the method is the relaxation of the pelvic floor, which is more complete than with any other anæsthesia.

The forceps operation, version and extraction, manual dilatation of the cervix, rotation and repair of cervical and perineal tears may all be painlessly performed by epidural anæsthesia, which may also be used in the removal of uterine contents in incomplete abortions, packing of the uterus, and in insertion of the colpeurynter.

The pains of normal labor may be controlled by this method, although the abolition of the pain reflex also takes away the voluntary effort of bearing down. Uterine contractions continue, however, so that if the parturient is instructed when and how to bear down, completion of labor occurs painlessly.

The feature of greatest difficulty is in the selection of the proper time to induce anæsthesia. Most cases could be made to terminate painlessly if the anæsthesia could be administered an hour to an hour and a half before delivery. In our experience, the maximal value of the anæsthesia results when not given until the os has reached at least 7 centimeters dilatation in primiparæ and at least 4 centimeters in multiparæ for average cases.

The field of usefulness in spontaneous delivery will greatly increase when a means has been devised to prolong the action of an epidural injection. Further investigation is necessary on this subject. It is possible that the drugs are already at hand, the proper combination and use of which will anæsthetize the entire pelvic floor and viscera for 5 or 6 hours without repetition. Such an anæsthetic should prove a great blessing in obstetrics and become the anæsthetic of choice in normal delivery.

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NEW APPARATUS FOR BLOOD TRANSFUSION WITH THE CITRATE METHOD

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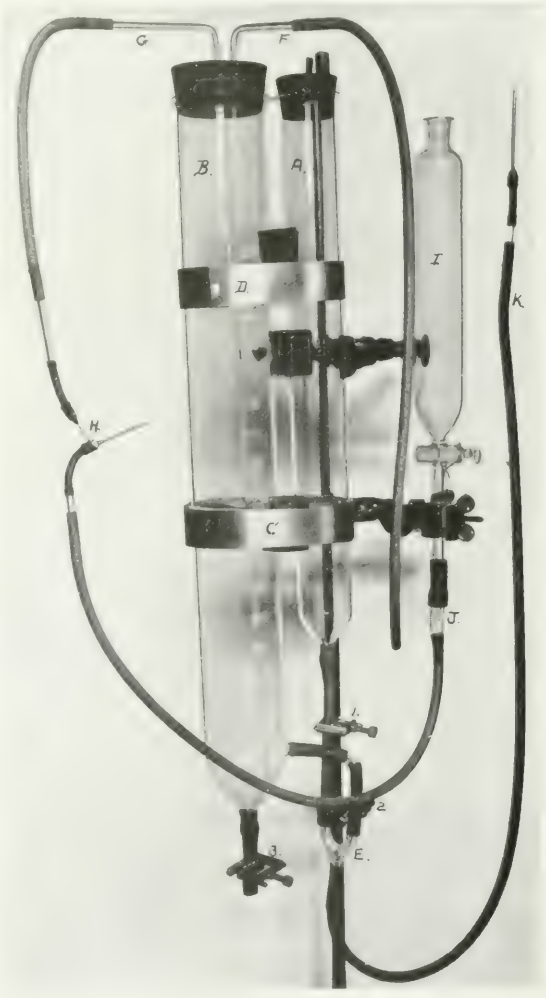
DURING the last few years there has been a notable increase in the use of blood transfusion, not only as a therapeutic measure in secondary anæmias, but especially in the treatment of severe infections, as puerperal septicæmia and thrombophlebitis subsequent to labor. In spite of numerous attempts to modify the direct method of transfusion, the indirect or citrate, method is the simplest and yields very satisfactory results. In the Woman's Clinic at Yale University, the latter method is frequently employed and the apparatus which we have devised so facilitates the procedure that commonly little more work is required than in giving an ordinary hypodermoclysis.

The apparatus illustrated consists of two cylinders: The smaller *A* is an ordinary 300 cubic centimeter infusion tube. The larger *B* is an especially designed 1000 cubic centimeter tube, 6.5 centimeters in diameter. These tubes are held together by two bands of aluminum (*C* and *D*) and are connected below by rubber tubing and a Y-tube of glass, as shown at *E*. Tube *A* is closed by a rubber stopper through which a small glass tube passes. Tube *B* is closed above by a rubber stopper perforated by two pieces of glass tubing. One of these, *F* is to allow for suction; to the second, *G*, is attached a short length of rubber tubing which connects with the needle to the donor. It is important that the second glass tube, *G*, reaches nearly to the bottom of the cylinder in order to prevent splashing and the subsequent coagulation of the blood. The glass and rubber tubing through which the blood flows from the donor should be of small diameter. In the apparatus in question, tubing 5 millimeters in diameter is employed. The donor's needle, *H*, is No. 15 gauge and 1½ inches in length. Into the base of this is soldered a No. 19 or No. 20 gauge needle. Rubber tubing connects the latter with the graduated separatory funnel, *I*. At *J* is a glass window through which it is possible to see any solution flowing from the end of the separatory funnel. By counting the number of drops per minute the rate of flow is readily measured.

The transfusion is carried out as follows: Approximately 100 cubic centimeters of sterile saline solution is put into the small cylinder. The three pinch cocks, *1*, *2*, and *3*, are opened and a small amount of salt solution is allowed to flow into the large cylinder, thereby filling the rubber connecting tubes with saline. Now pinch cocks *1* and *2* between the cylinders are closed; and after the saline solution that has collected in the bottom of the large cylinder has run out, pinch cock *3* is closed. The separatory funnel, held in a convenient position by a clamp on the stand, is filled by a 2 per cent sodium citrate solution. Approxi-



mately 15 cubic centimeters of the latter solution is now allowed to flow through the rubber tubing and donor's needle into the large cylinder *B*. In this way the entire system of tubing is citrated before the collection of blood begins.

After preparing the donor's arm with tincture of iodine and alcohol, the needle is inserted into a prominent vein at the elbow. When blood enters the needle the stop cock of the separatory funnel is so adjusted that the rate of flow of the citrate solution is approximately 2 drops per second. Naturally the rate varies, depending upon the rate of the blood flow, but the final mixture represents 15 cubic centimeters of citrate solution to every 100 cubic centimeters of blood. To give the blood to the recipient the long rubber tubing *K*, with its glass window, is removed from the hole in the rubber stopper between the upper ends of the two cylinders and, depending upon the size of the recipient's vein, connected to a No. 16 or No. 18 gauge needle. After the tube and needle have been filled with saline, the flow is temporarily arrested by pinching the tube with the fingers, and the needle is inserted into the recipient's vein. The pressure upon the tubing is then released and the apparatus lowered below the arm so that a negative pressure is established in the needle. As soon as the blood flows from the vein into the needle, the colored saline solution can be seen through the glass window. The tourniquet previously wound about the arm is now released and the apparatus is elevated. When the flow of saline is well established, the solution is shut off by closing pinch cock *1*. Pinch cock *2* is now opened and the blood in *B* is allowed to flow slowly into the recipient's veins. If clots should form, they will settle to the bottom of cylinder *B*, and will not pass over into the rubber tubing. If the transfusion proceeds too slowly or if the needle is pulled out of the vein, the blood can be shut off by closing pinch cock *2*, and the tube and needle can be flushed out by opening pinch cock *1*. The latter factors have so facilitated the procedure that when the apparatus has been employed it has been necessary to expose the recipient's veins only when they were unusually small or collapsed subsequent to a severe hæmorrhage.

The observations of Clough, DeKruif, Drinker and Brittingham, Hartman, Satterlee and Hooker, and others confirm our experience that incipient coagulative changes play an important part in causing chills following transfusions. Citration within the needle is the most logical procedure to avoid these changes. We have found that the method described not only eliminates all clot formation but materially decreases the number and severity of the chills subsequent to the intravenous administration of blood.

ADVANTAGES

The chief advantages of the apparatus are:

1. Saline solution is always available.
2. The blood is citrated within the donor's needle, thereby avoiding as much as possible incipient coagulation changes.
3. A closed method for transfusion is provided which eliminates the necessity of transferring blood from one container to another.
4. The apparatus is simple and is easily manipulated, and when it is employed the assistance of but one person is necessary.

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THE TREATMENT OF PRURITUS VULVÆ[1]

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IN a sense pruritis vulvæ is a symptom and not a disease. Yet there are many cases in which it persists *per se* without any concomitant symptoms, or discoverable etiological factors, and attains the dignity of a clinical entity.

The intense suffering to which it may give rise is well known. Indeed, in extreme instances it may make life wellnigh insufferable for its victims. There has been much discussion as to whether this pruritus is a local disease or a neurosis. In any event, there is an irritation of the vulvar nerve endings interpreted as itching. This in turn brings on the impulse to scratch, and so a vicious circle is established, which persists long after a leucorrhœal discharge, or other etiological factor, has ceased to operate.

The treatment of this condition has been notoriously unsatisfactory. Indeed, the multiplicity of remedies employed bespeaks their futility. Of course, where there is a distinct etiological factor, such as a leucorrhœal discharge, diabetes, or a local eczema which is part of a generalized eczematous tendency, the treatment must be that of the causative factor. Such cases usually improve readily when the underlying cause is removed.

Excluding all such cases, there still remains a group in which the pruritus presents itself as an essential condition. This usually occurs in women close to, or past, the menopause. The vulva is more or less atrophic, the skin is infiltrated, and has often a greyish-red, somewhat glazed appearance. In long standing cases there are added the secondary changes induced by scratching and consequent infection.

It is in this class of apparently essential cases that I have been using what I believe to be a new treatment for this condition. It is based upon the belief that the itching is due to an irritation of the nerve endings, and that the consequent scratching gives rise to a vicious circle of cause and effect which must be broken into to effect a cure. The treatment consists in repeated infiltrations of the vulva with a non-toxic local anæsthetic. The principle is, of course, not new. Many forms of irritation of sensory nerve endings, interpreted as pain, have been treated heretofore by infiltration of the nerve trunk or nerve endings.

The technique employed is very simple. The skin and subcutaneous tissue along the outer border of the labia majora are continuously infiltrated with a 1 per cent solution of novocain. Eight cubic centimeters are used at one sitting, 4 cubic centimeters being injected on either side of the vulva.

No curative effect is attributed to the novocain. Its purpose is merely to render the infiltration itself painless. The curative action is attributed rather to the mechanical effect of the infiltration, and could doubtless be achieved, though in a less painless way, with salt solution.

All cases have been readily treated in the outpatient department. The injections have been repeated at intervals of a week. No case has received more than five injections; in some patients from one to three have sufficed.

The results have been distinctly encouraging. It is too early to report final statistical results; that is not the object of this preliminary report. There have been a few cases that must be classed as failures. The majority have been vastly improved, and in such a way as cannot be attributed to an ephemeral effect of the novocain. About half the cases have been definitely cured. That is to say, they have been symptom-free for prolonged periods, after having suffered for months or years before this treatment was instituted.

In view of the very unsatisfactory results hitherto obtained in the treatment of pruritus vulvæ, the author feels that this method is worthy of a trial by others. The number of cases of "essential" pruritus occurring on even a large out-patient service is small. In order to give this method a trial in a sufficient number of cases to properly evaluate it, it will be necessary to employ it in more than one clinic. In this connection it must be emphasized again that cases with leucorrhœal discharge, diabetes, or general eczema must receive treatment appropriate to those conditions. It is only in the "essential" cases that this treatment should be tried. Obviously it is useless to attempt a cure when such an active causative factor is present.

Some of our successful cases showed little or no improvement after one or two treatments. It is not sufficient to stop the injections at this point; they must be persisted in for a number of weeks. When a series of four or five injections does not bring about any improvement, the treatment is of no avail. As a rule there is a temporary improve-

[1] From the gynecologic service (Dr. Joseph Brettauer) at Mount Sinai Hospital.

ment after each injection, and then a recurrence which becomes less and less marked after each treatment.

A summary of seven successful cases follows.

Case 1. Dispensary No. 2860. A. C., age 58. June 26, 1922. Florid type of complexion; dry eczema of thighs and buttocks; vulva atrophic with excoriations from scratching. Intense pruritus vulvæ for 1 year. Novocain injection given. July 3, 1922, condition much improved; only slight itching persists. Second novocain injection, July 17, 1922. Itching has ceased after two injections.

Case 2. Dispensary No. 1439. A. M., age 62. Patient wears a pessary for prolapse. Severe pruritus for 3 weeks. Vulva atrophic, otherwise negative. April 29, 1922, novocain injection. June 16, 1922, itching has ceased. December 21, 1922, patient remains symptom-free after 8 months.

Case 3. Dispensary No. 453. R. G., age 48. May 9, 1922. Pruritus of 8 months' duration. Vulva has a greyish glazed appearance. Novocain injection, May 16, 1922. Complete relief for 4 days; itching has now returned. Novocain injection, May 23, 1922. Itching has ceased. Now complains of irritation of clitoris. Ten per cent silver nitrate applied to clitoris. May 29, 1922. No further itching. Irritation of clitoris improved. June 5, 1922. Intense itching since yesterday. Novocain injection. June 26, 1922. Itching was relieved for some time, now has returned. Novocain injection. July 10, 1922. Occasional slight itching but not daily. February 1, 1923. Has been free from itching for over 6 months; vulva has resumed a normal appearance.

This case was cured by a series of four injections extending over a period of 6 weeks.

Case 4. Dispensary No. 5174. M. R., age 50. January 23, 1923. Severe pruritus for 2 years. Vulva red and glazed, excoriated, infiltrated. Novocain injection, January 30, 1923. Pruritus has ceased; some itching of inner surface of thighs, where there is eczema. February 7, 1923. No further itching of vulva. Eczema of thighs improving under ointment. This case was lost from further observation; a pruritus of 2 years' standing appears to have been relieved by a single injection.

Case 5. Dispensary No. 3776. M. T., age 44. June 9, 1922. Pruritus vulvæ for several months; vulva atrophic, shows scratch marks. Novocain injection, June 16, 1922. No improvement. Novocain injection, June 23, 1923. Much improved. January 6, 1923. Has remained well for 6 months, except for occasional slight itching in region of clitoris; none in rest of vulva; no scratching.

Case 6. Dispensary No. 4978. B. S., age 33. December 5, 1922. Pruritus for 3 months. Labia thickened, red, glazed; clitoris hypertrophied. Novocain injection. December 12, 1922. Condition was improved for 1 day, then worse than ever. Novocain injection, December 19, 1922. No itching for past 4 days. March 13, 1923. Has remained well for 3 months.

Case 7. Dispensary No. 2932. A. S., age 57. April 27, 1922. Pruritus of long standing; labia infiltrated; vulva shows scratch marks. Novocain injection, May 6, 1922. Still some itching; novocain injection, May 11, 1922. Slight itching. Novocain injection. June 16, 1923. Itching has ceased. February 1, 1923. No further itching; vulva normal in appearance. Patient free of symptoms for 7 months following three injections.

EDITORIALS

SURGERY, GYNECOLOGY AND OBSTETRICS

FRANKLIN H. MARTIN, M.D. ..... Managing Editor
ALLEN B. KANAVEL, M.D. ..... Associate Editor

DECEMBER, 1923

THE "ULCERATED TOOTH"

THE above term commonly designates an acute exacerbation of a previously quiescent peri-apical infection; this naturally and by common consent will call for the ministration of the dental surgeon. The attack may terminate or be terminated in one of several ways. After two days of suffering an abscess may perforate the bone causing the typical "gum boil" or less commonly it may burrow out alongside of the root of the tooth. The dentist may get drainage through a root canal, or an attempt may be made to abort the process by extracting the tooth. The latter treatment has the virtue of precluding future attacks and may be followed by quick recovery, by a more or less protracted or stormy convalescence, or occasionally by death from general sepsis.

It was an old teaching in dentistry that these teeth should not be pulled during the period of acute swelling, and there is often sound clinical observation back of these older teachings. With more modern and antiseptic technique, the general trend is to substitute active intervention for cultured conservatism and above all with the advent of the "exodontic" specialist, this older teaching lost precedence. The apparently more rational procedure of establishing free drainage and at the same time removing the supposed focus is apt to appeal more strongly to the new dentist. This procedure has been compared to the removal of an acutely diseased appendix but the simile is inapt because the appendix is the focus of the infection while the tooth is at this time but an inert plug. In their results the two procedures do not parallel and the observer standing on the side line, who takes occasion to sort over the wreckage, is apt to conclude that the average results do not justify the extra risk inherent to early extraction. In a certain small percentage of cases the reaction is accompanied by an increase of symptoms, or is followed by abscess formation, or extensive bone necrosis. In addition to this some young or apparently robust people will die from general sepsis following the extraction of an "ulcerated tooth" in the acute stage. On the other hand, except among enfeebled old people, death following the conservative plan is extremely rare and except among young children, cervical abscess or extensive bone necrosis is uncommon, where the tooth and the bone are spared the trauma of instrumentation in the acute stage of the infection.

This may seem difficult to explain but a study of the history of a typical case will at least furnish food for thought.

The "ulcerated tooth" is a fulmination of an infection that has been present for an indefinite time, possibly years, without giving more than mild or unidentified symptoms. Often the root canals of the damaged tooth were long ago sealed by the dentist and it is usually difficult to assign any logical cause

for the explosion. About the simplest explanation is the assumption that a disturbance of the balance between virulence and resistance has occurred which permits the hitherto imprisoned bacteria successfully to attack the confining barriers. This low resistance may be the reason why the trauma of an extraction may not be well tolerated at this particular time. This type of acute osteomyelitis should hold more than an academic interest for both the physician and the surgeon, either of whom must occasionally help a patient to choose between the man who offers immediate and permanent relief from a jumping toothache by a painless extraction under gas, and the old-fashioned dentist who prescribes quinine, phenacetin, the mustard foot bath, and the fig poultice, and who may attempt to establish drainage by the somewhat painful process of opening a root canal. The former may be the more brilliant procedure, but we can still give the conservative man our moral support with the assurance that his plan is the safer. Besides, the physician can always add sufficient morphine at least to ease the time of travail or possibly he may shorten it by an incision and a stripping up of the periosteum at the likely site of perforation.

At a later period when the balance between virulence and resistance has been re-established in the patient's favor, extraction of the tooth is not only safe but is better surgery than the most effective dental restoration.

This taboo against immediate extraction applies only to the period of acute local symptoms evidenced chiefly by swelling of the neighboring soft tissues and by the pain and tenderness that are characteristic of early osteomyelitis, not to the subacute stage in which discomfort, low fever, adenitis, malaise, rheumatism or joint infections etc., may evidence chronic infection. If, however, an extraction under these latter conditions is followed by a severe local flare up, then there may be good reason to go slow on repeating the insult. V. P. Blair.

SUPRAPUBIC PROSTATECTOMY AS A ONE-STAGE OPERATION

THE operation of prostatectomy developed, in the early years of surgery of the bladder, through perineal or suprapubic drainage for urinary retention and the removal of vesical calculi. In the natural evolution, perineal and suprapubic methods were developed, and the latter is now most universally employed because of its direct attack, in cases of benign hypertrophy on the part of the gland involved, that is, the lateral and median lobes. Furthermore, associated lesions of the bladder, vesical calculi, diverticula, and, rarely, carcinomata are readily accessible through the suprapubic cystotomy.

The uniformly high mortality rate in the early years of prostatic surgery, a result of performing prostatectomy in the presence of chronic retention and renal insufficiency, led to the two-stage operation of suprapubic cystostomy preliminary to prostatectomy, which markedly reduced the mortality rate. However, the performance of a preliminary cystostomy in the presence of prolonged chronic retention and marked renal insufficiency is not without danger, and is accompanied by a definite mortality rate. Death from uræmia following preliminary suprapubic cystostomy is just as much a failure in the successful management of prostatic obstruction as death from the prostatectomy itself, and should be included in the mortality rate of the operation; for, whether death occurs following the first or second stage of the operation, the result is the same so far as the patient is concerned. Experience has shown that patients surviving the preliminary operation

and recovering from uræmia will pass through the second stage, or removal of the prostate, with an exceedingly low mortality rate. The diminished mortality rate of the two-stage operation has commended its use and led to its general adoption. However, it possesses the disadvantage of inaccuracy in the conduct of the second stage. A recent cystostomy forbids the wide exposure of a one-stage operation and necessitates a blind enucleation of the gland, which at times results in failure to remove all of the obstructing gland, or to control the bleeding accurately.

Recognition of the fact that all patients with prostatic obstruction are potentially, if not actually, uræmic, and the endeavor to improve the renal condition before prostatectomy have been primarily responsible for the recently diminished mortality rate. Recognizing that the preliminary suprapubic drainage produces improvement in the renal condition and general condition of the patient, the disadvantages of the second stage of the two-stage operation are overcome by instituting preliminary drainage of the bladder by a permanent urethral catheter instead of suprapubic cystostomy, which converts the procedure into a one-stage operation. The method of gradual decompression of the bladder in the presence of acute or chronic retention and uræmia, as described by von Zwallenberg and Bumpus, has largely obviated the necessity of suprapubic drainage and has avoided precipitate acute uræmia and death.

Permanent drainage by urethral catheter preliminary to the one-stage prostatectomy is successfully carried out in 76 per cent of the patients with benign prostatic hypertrophy. It is still advisable to remove the prostate subsequent to, rather than simultaneous with, the removal of vesical calculi and excision of diverticula or new-growths in the presence of renal insufficiency. Less than 10 per cent of patients are intolerant to the permanent urethral catheter. Permanent urethral catheter drainage of the bladder facilitates a single operation, and permits the application of the general principles of surgery to the operation of prostatectomy. In the past, the operation has been carried on in the dark by the use of the sense of touch only. The one-stage operation facilitates exposure and visualization of the entire procedure, insuring complete removal of the obstructing gland and irregular tags at bladder neck, and permits of accurate control of all bleeding.

The evolution of prostatic surgery has carried it well beyond the question of how quickly prostatectomy may be performed, but demands accurate application of the general principles of surgery to insure a low mortality rate and the best functional results. It is no longer to be expected that a patient's urine will contain blood for days after prostatectomy. In surgery of the prostate, the application of the principles of hæmostasis, applied elsewhere in the body, is equally effective, and the mortality rate bears a direct relationship to the loss of blood.

Sacral anæsthesia combined with abdominal infiltration affords complete relaxation for exposure and visualization of the operative field, and has displaced the use of general anæsthetics which, in the past, on account of their depressant effect on the kidneys, have sacrificed accuracy to technique for speed.

Uræmia, hæmorrhage, pneumonia, and general sepsis have been responsible for the high mortality rate in prostatic surgery in the past. The careful pre-operative preparation, and treatment of the actual or potential uræmia, the use of local anæsthetics, and accurately visualized conduct of the operation have decreased the mortality rate to a minimum, and insured excellent functional results.

VERNE C. HUNT.

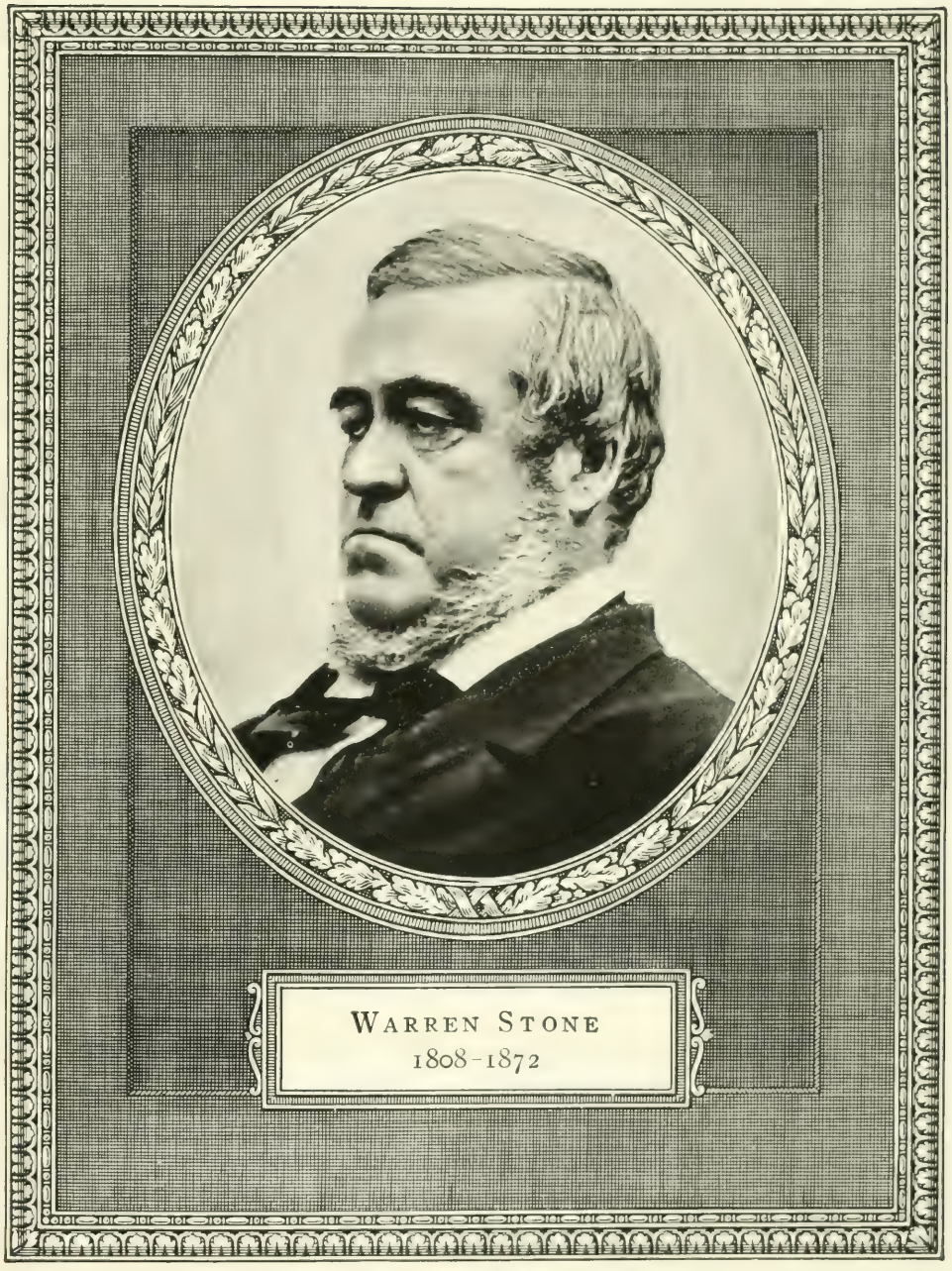
MASTER SURGEONS OF AMERICA

WARREN STONE

WARREN STONE was born at St. Albans, Vermont, February 3, 1808. His father, Peter Stone, was a farmer, and his mother, Jerusha Snow, from whom he inherited his physical development and the high intellectual and moral tone that spurred his ambition on to fields of noble enterprise beyond the limits of his narrow home. When he died, December 6, 1872, at the age of 64, this venerable mother survived him. To her he owed his remarkable physique and from her he derived, says one of his biographers, truth, honesty, philanthropy and self-reliance so conspicuous throughout his life.

These qualities, in spite of his meager opportunities for education, enabled him to reach a high degree of eminence as citizen and member of the medical profession.

His primary education was the scanty schooling of a fatherless boy in New England. His mother, however, supplemented these deficiencies, aiding him materially in his preparation for the study of medicine. He graduated from the Medical School of Pittsfield, Massachusetts, in 1831, and began the practice of medicine in Troy, New York. Here he attended the first cholera case brought to Troy by emigrants from Quebec and Montreal, fleeing to the states by way of Lake Champlain. Dr. Stone recognized the disease and attended the first victim. Thirty-five years later in a paper on cholera he wrote: "It so happened that my professional life and the cholera in this country commenced together." Fortunately, for New Orleans and the South, his career did not end with the cholera. This was but the prelude to his exciting experience with this disease on the cholera ship "Amelia," on which he embarked for New Orleans where he wished to settle and practice. The brig left New York with 108 passengers. Four days out a great storm necessitated the closing of the hatches to keep the vessel from sinking. When the storm abated Dr. Stone found twenty-five of the passengers in the second stage of cholera. The ship was beached off Folly Island, near Charleston, and the disease was carried to the island. The island belonged to Mr. Alexander Milne, who opened his house to the sick and destitute, generously furnishing them with supplies. Charleston quarantined the island but sent down physicians to look after them. Dr. Thomas Hunt, a native of Charleston and born in the same year as Dr. Stone, was put in charge and was ably assisted by young Stone.



WARREN STONE
1808-1872

Here they met for the first time and here was formed that friendship which continued during their lives. Another ship was chartered and Dr. Stone continued his journey to New Orleans where he arrived in December, 1833, with one picayune in his pocket, which he often said he preserved for the sake of a nucleus. In that year cholera had claimed six thousand victims in a population of fifty thousand, at a time when yellow fever was also prevalent. Through the kindness of one of the physicians, Dr. Stone was appointed at first to a subordinate position in the Charity Hospital. A few months later Dr. Hunt, his acquaintance and friend of Folly Island who had moved from Charleston to New Orleans, became house surgeon. Through his recommendation largely Dr. Stone became a year later assistant house surgeon, under Dr. Harrison, house surgeon on the resignation of Dr. Hunt, who had conceived the idea of founding a medical college in New Orleans. Dr. Hunt, Dr. Harrison, and Dr. Stone were all born in 1808. They all became practically and closely associated in the medical college. Medical education at this time was at a low ebb. Colleges were the product of private enterprise, organized as stock companies, composed of medical graduates. Their maintenance was dependent solely upon the number of medical students and the amount of their fees. Naturally standards had to be arranged to increase the number of students. The medical college of Louisiana, the germ of Tulane University, was just such a stock company, the outcome of Dr. Hunt's enthusiasm and energy. He delivered the introductory lecture in September, 1834. Although the requirements were low, the excellence of the faculty was largely instrumental in building up the attendance.

Dr. Stone was a huge, rugged man; his unusual height and weight were made more conspicuous by his massive head and his imposing features. He filled the position of demonstrator, lecturer and professor of anatomy during the first few years of the college, and in 1839 was made professor of surgery, which chair he held until his resignation early in the year of his death.

Dr. Stone was a very conservative surgeon, but by his sound common sense did much for surgery. In his lectures and conversation he displayed a faculty for anecdote and quotation. He was genial and frank, but not hilarious. He was not gifted with original wit or humor, but thoroughly appreciated it in others. He had a dislike for presumption and pretention, but was always generous in his estimate and treatment of others. He was himself modest and unpretending but not oblivious of his own merits. Dr. Stone's memory was unsurpassed and his reading extensive. In his lectures and addresses, he did not use memoranda, depending entirely upon his memory. He wrote little, so that, unfortunately, we have little record of his vast experience. He was, however, formidable in discussion, so vivid were his recollections, and so keen was his logical power of expression. He had the *tactus eruditus* remarkably well developed. He was editor of the *New Orleans Medical and Surgical Journal* from 1857 to 1868. A

few articles published in this journal comprised his contributions to medical literature, such as "Amputation of the Mammæ," "Ligature of the Femoral Artery," "Ligature of the Carotid, Ligature of the Vertebral, and the Treatment of Wounded Arteries." "Hernia and Obstruction of the Bowels," some clinical memoranda and notes from Dr. Stone's lectures, were published by his son, Dr. Warren Stone, Jr., just before his death.

No surgeon of the South ever enjoyed a more widespread reputation with the profession and the general public. As a man he was noted far and wide for his wisdom and by his patients he was affectionately regarded. He was very charitable but unostentatious. Professor S. D. Gross once called him "The Great Commoner of Medicine" and so great was his name in the city and so beloved was he by the people of New Orleans that when he died, December 5, 1872, the District Courts were adjourned as a mark of respect, the flags of shipping stood at half mast, and many of the stores were closed during the funeral.

Though a native of New England he sided with the state of his adoption when it seceded from the union and won the admiration of her people and the respect of her enemies.

FREDERICK W. PARHAM.

TRANSACTIONS OF SOCIETIES

CHICAGO GYNECOLOGICAL SOCIETY

Regular Meeting Held April 20, 1923, Dr. Henry F. Lewis Presiding

PREMATURE SEPARATION OF PLACENTA

Dr. William C. Danforth: I wish to report a case of premature separation of the placenta which resembles closely one which Dr. Paddock reported at a previous meeting. The patient was a primipara, age 22, at term with a large child with unengaged head. She came to the hospital because of occasional pains. During the night sudden abdominal pain occurred followed by active external hæmorrhage. I was in the hospital at the time, saw her at once, and found a dilatation of one finger's breadth only and continuing active bleeding. Fetal heart tones were audible and strong. With no dilatation and unengaged head labor undoubtedly would have been long. Section was, therefore, done at once, the child being saved. The placenta was found partially detached. The value of immediate attention to obstetric emergency is well illustrated, as it enabled us to save the child, a rather infrequent result in cases of this type.

Dr. Arthur Curtis read a paper entitled "Management of Female Urinary Bladder after Operation and during Pregnancy: a Further Study of Residual Urine in Its Bearing on Urinary Tract Disturbance:

FRACTURE OF THE PELVIS DURING PREGNANCY

Dr. Carey Culbertson: I wish to make a short report of a case of fracture of the pelvis which occurred in the latter months of pregnancy without interruption of the pregnancy which was terminated by cæsarean section.

The patient was a young woman, 28 years of age, in her first pregnancy. Her last period occurred September 20, 1920, and the eighth May following, while motoring near Danville, Illinois, the automobile in which she was riding was overturned. She was pinned underneath the car, sustaining an injury of the hip and arm, a laceration of the scalp, and a fracture of the pelvis. She was brought into the hospital 8 hours after the accident with the arm and head in bandages. The scalp wound had been sutured with catgut. X-ray plates of the pelvis region showed a double fracture. The plate here reproduced shows an oblique fracture of the upper ramus of the right pelvic bone a transverse fracture of the lower ramus, and an oblique fracture through the body of the left pelvic bone with moderate separation of the symphysis pubis. Incidentally, this plate also shows the fetal head and other portions of the fetal skeleton, and reveals six lumbar vertebræ instead of five. There was no evidence of injury to the bladder. It was at this time that I was called in consultation and the patient was treated conservatively. At no time was there pain due to uterine contractions. Six weeks later, on the twenty-ninth of June, she was delivered by cæsarean section by Dr. A. M. Miller of Danville, to whom I am indebted for the details of this report. Labor came on spontaneously and with the first pain the membranes ruptured, whereupon the section was at once performed. The patient has made a normal convalescence and was discharged from the hospital July 15.

This case is of particular interest in showing extensive fracture of the pelvic bones, sustained approximately six weeks prior to term, without interference with the pregnancy in any way.

RUPTURE OF THE UTERUS

Dr. David S. Hillis: I wish to report a case of ruptured uterus which was recently admitted to the Cook County Hospital. The patient entered the hospital on February 18 and went home on March 12. She was a II-para and had had no miscarriages. Fifteen months ago a cæsarean section of

Fig. 1. Fracture of pelvis sustained in eighth month of pregnancy. (Case of Dr. Culbertson.)

the classical type was done at the Cook County Hospital. During the puerperium she had considerable temperature which was believed to be due to respiratory infection. She was discharged cured on the twelfth day with her baby. Her last menstruation was May 24, 1922, date of expected confinement March 1, 1923. The day before admission to the hospital the patient fell on the sidewalk but noticed nothing unusual until 24 hours later. While sitting at the breakfast table she was suddenly seized with a pain in the abdomen, started to walk to a couch, and fell to the floor on account of the severity of the pain. She managed to crawl to the couch and had another sharp pain which was so severe that she called a doctor. The doctor left some medicine, after which the patient felt better for a time, but soon thereafter became so sick she applied for admission to the County Hospital, 12 hours after the onset of the attack. On examination she was found to be in considerable shock, very pale, with systolic blood pressure of 55, diastolic questionable. The abdomen was somewhat soft throughout, with dullness in the flanks and a tympanitic area over the epigastrium. Under the old cæsarean scar was a soft mass which felt like the unruptured bags of water immediately under the abdominal wall. The fetal parts could be palpated with abnormal distinctness, but there was no mass to correspond to a ruptured and contracted uterus to be felt in the abdomen.

Vaginal examination revealed a cervix not large, and not dilated; no presenting part felt. Conjugata vera 7.5 centimeters. Her hæmoglobin was 80 per cent. Reds 4,250,000. Pulse not perceptible at wrist. Temperature 97.4°, respirations 26. She was given 800 cubic centimeters of intravenous salt solution and one-quarter grain of morphine. An immediate operation was done. The placenta was found lying immediately under the old scar in the anterior abdominal wall, maternal surface upward. The fetus was found lying among the intestines, entirely outside of the uterus. There was a small amount of free blood in the peritoneal cavity, showing that not much hæmorrhage had taken place and accounting for the fairly good condition of the patient. The uterus was removed on account of the extent of the tear in the anterior wall and because it was so firmly contracted that the edges could not be brought together and sutured without considerable difficulty.

The opening in the uterus included the entire length of the body and part of the fundus, and extended downward for about one-half inch toward the right in the lower uterine segment. Operation required 45 minutes and the patient left the hospital well on the twelfth day.

This case indicates that if the tear in the uterus is large enough so that it may expel all of the contents it may contract down and thus prevent fatal hæmorrhage. The scar resulting from a previous cæsarean section, which has gone through a febrile puerperium, is not to be trusted in a subsequent labor. This uterus ruptured spontaneously, in the early part of the ninth month.

VASA PRÆVIA AND PLACENTA PRÆVIA MARGINALIS

Dr. C. D. Hauch: This specimen is a placenta weighing 1300 grams, from a case of placenta prævia marginalis. There is also a velamentous insertion of the cord. The patient, a V-para, flowed last on August 15, 1922, but felt life November 1. In January a diagnosis of polyhydramnios was made. By April 1 the top of the fundus was 40 centimeters above the symphysis, but the position of the fetus could not be outlined. The patient's condition demanded induction of labor. When the membranes were ruptured the cord prolapsed and the breech presented in the right sacroposterior position. The cervix was easily dilated, the cord drawn upward, but there still remained at the cervical outlet a mass of large veins, later found to be a true vasa prævia. Rapid extraction was decided upon as the child was making respiratory efforts when the foot was delivered, and the low implantation of the placenta had not given rise to hæmorrhage. Delivery was accomplished without injury to the mother, but the child was asphyxiated. The placenta which was removed manually extended from cervix to fundus.

Dr. William R. Meeker, Rochester, Minnesota, read a paper (by invitation) entitled "Regional anæsthesia in Gynecology and Obstetrics." (See p. 816.)

THE TREATMENT OF CARDIOPATHS IN PREGNANCY AND LABOR

Dr. William C. Danforth read a paper on the management of cardiopaths in pregnancy and labor. (See p. 774.)

DISCUSSION

Dr. Rudolph W. Holmes: No one who has a custom of making a routine physical examination of all obstetric women can escape finding repeatedly, and rather frequently, cardiac lesions. The vast majority of such valvular cases pass through pregnancy and labor uneventfully. Ever since McDonald, in 1878, issued his volume on heart disease in the obstetric relationship, and made the complication an extremely grave one for the woman, all other writers have followed his lead with lugubrious deductions. Fellner illustrates this in his résumé of heart disease in the Vienna clinic. The whole trouble is that writers place the results of their grewsome findings from deductions of cardiopaths with broken compensation. In my own work I have seen no near disasters accompanying valvular lesions unless there be stories of attacks of broken compensation, antedating the pregnancies.

Some years ago a woman came to me with a statement that three physicians had demanded that she have an immediate therapeutic abortion for a

double mitral lesion. In view of the fact that she had not had a muscular disturbance of her heart since her initial attack some 10 years before I urged that she go through the pregnancy, acting when action was required. She had a perfectly normal, easy confinement with no cardiac disturbance. After her delivery I strongly urged the couple to see that conception never occurred again. But, a week ago she returned from New York for a second confinement due the middle of May. The day after seeing me in my office her heart broke, and the next day she went into labor, she notifying me only when labor had started: the labor lasted 3 hours, though I delivered her instrumentally when the head was crowning on account of the marked effects of the loss of compensation. She nearly died, but fortunately, she passed the crisis.

I believe the sum total of wear and tear on a cardiopath is as great following a cæsarean section as a properly conducted labor: the one advantage of a section is that it permits a coincident removal of the tubes. We may not question but that pregnancy and labor has its deleterious effects on a heart with a valvular lesion even though at the time no evident injury is produced. Later the heart muscle will show that it has been compromised. Rarely should a therapeutic abortion be done for a cardiopath, but pregnancy always should be looked upon with some apprehension is such women, and discountenanced if even slight periods of cardiac stress have manifested themselves. The problem of the cardiopath should be worked out by the internist and the obstetrician together.

Dr. Charles E. Paddock: One never knows how a heart which has been injured by disease will act with the strain of pregnancy or labor. Whatever the lesion I always want an internist to share the responsibility with me. I have had patients go through labor and pregnancy with serious lesions of the heart in safety, and again at the last moment I have had a comparatively simple heart lesion call for immediate interruption of the pregnancy. Associating myself, therefore, with an internist has undoubtedly been of great benefit not only to the patient but to me.

Generally speaking, whatever the lesion a patient should not be allowed to remain long in the second stage of labor whether the heart be compensating or not. Pregnancy should be interrupted where symptoms develop which shows circulatory disturbance. Generally these symptoms come in the latter month of pregnancy when the child is viable. The question then arises as to the best method of terminating the pregnancy. Both in the interest of mother and child, there is no doubt in my mind that the cæsarean operation is in the majority of such cases the operation of choice. Local anæsthesia can be used and the woman delivered with comparative comfort. This allows sterilization of the patient.

Dr. Carey Culbertson: I think that Dr. Danforth has emphasized adequately the importance of the functional capacity of the heart rather than the type of lesion. No one can tell—at least, I am sure I have never been able to prognosticate—what a heart that has a lesion is going to do whether compensated or decompensated, at the time of labor. We all know that a woman with a valvular heart lesion often can go through labor without help, but that is no reason why she should be allowed or expected to do so without help.

The last cardiopath who died under my care was also an eclamptic. Convulsions ceased after delivery, and the toxic condition was clearing up when, on the fourth day after delivery, the heart which up to that time was compensated, went suddenly to the bad and the patient died in a few hours.

I believe that if these hearts should be saved during pregnancy they should be saved in labor. A patient who lives on the second or third floor should not run up and down stairs during pregnancy, and she should not be allowed to bear down during labor in any case, whether the heart is compensated or not. She should be delivered by artificial aid in order to avoid the strain of bearing down. This was Webster's teaching, and I am sure is good teaching.

The feature of anæsthesia I have spoken of before in cases of this sort. I do not think that nitrous oxide gas is the proper anæsthetic in heart lesions whether the heart is compensated or not. I make this a rule to be followed not only in obstetrical but in gynecological cases as well.

Dr. Paddock's experience is exceptional and due in at least one instance, to good fortune, for one of his patients died under my care, when he was absent on vacation. This was one of the worst cases of decompensated heart that I ever saw.

Dr. Danforth (closing): I wish to thank the gentlemen who were good enough to discuss my paper. I think the point as to the functional capacity of the heart, as Dr. Gilbert emphasized, is by all means the most important single thing concerning the pregnant woman's heart, and the fact that she has murmur is of secondary importance. The work the heart is called upon to do is of primary importance.

The influence of infection of which Dr. Gilbert speaks is important. While I did not go into that in the paper, all infections present in a pregnant woman deserve unusual attention, especially infections about the teeth, tonsils, and sinuses.

As to cæsarean section in heart cases no doubt many do come out well. However, as a routine thing, I would maintain the ground which I took in the paper, that is, they are more safely delivered by the vaginal route.

Dr. Culbertson's emphasis upon removal of the strain of the second stage of labor in the cardiac case is important even in a woman with a minimal decompensation, and where marked decompensation is present, without question the child should be extracted operatively.

AMERICAN COLLEGE OF SURGEONS

STATE AND PROVINCIAL MEETINGS OF THE CLINICAL CONGRESS OF AMERICAN COLLEGE OF SURGEONS

MANITOBA; ALBERTA AND SASKATCHEWAN; MONTANA AND NORTH DAKOTA; OREGON AND IDAHO; WASHINGTON AND BRITISH COLUMBIA; AND UTAH, COLORADO, WYOMING, AND ARIZONA.

THE autumn group of sectional meetings of the American College of Surgeons for 1923 was completed with the Denver meeting on October 4 and 5, last. Without doubt the six sectional meetings in this group were, on an average, the most successful and enthusiastic which the College has had.

MANITOBA

The Manitoba Sectional Meeting was held in Winnipeg on the 10th and 11th of September. The headquarters were at the Fort Garry Hotel, and clinics were conducted at the Winnipeg General and St. Boniface Hospitals.

The visiting speakers were Dr. Charles H. Mayo, Rochester, Minnesota; Dr. James T. Case, Battle Creek Sanatorium, Battle Creek, Michigan; Dr. Malcolm T. MacEachern, Chicago; Rev. C. B. Moulinier, S.J., Milwaukee, Wisconsin; and Dr. Allan Craig, Chicago.

The hospital meeting was held in the Fort Garry Hotel on the first afternoon and drew an attendance of over three hundred. The public meeting, which had an attendance of sixteen hundred, was held on the evening of the first day in the Concert Auditorium of the hotel. Long before the time for the opening of the meeting this auditorium was packed and there was standing room only. It was necessary on this account to open the large Ball Room and this was also filled to capacity. Every speaker on the program was required to speak twice, and even with these two auditoriums available some four or five hundred were unable to gain admission. During the morning of the first day Dr. Charles H. Mayo gave a clinical talk at the University Medical School, and on the morning of the second day Dr. James T. Case also gave a clinical talk and demonstration at St. Boniface Hospital. On both of these occasions there was a very large attendance. The scientific meeting on the second afternoon was well attended. The clinics were carefully prepared and systematically conducted. In fact, every detail in connection with the meetings was thoroughly planned and executed by the energetic local committee, to whom our thanks are due.

ALBERTA–SASKATCHEWAN

The Alberta and Saskatchewan Sectional Meeting was held in Edmonton on September 14 and 15. Headquarters were at the MacDonald Hotel. The arrangements for these meetings were in the hands of the local Fellows who were assisted in the publicity by Mr. John Blue, secretary of the Chamber of Commerce. The organization of these meetings was everything which could be desired.

The hospital meeting, held on the afternoon of the first day at the MacDonald Hotel, drew an attendance of approximately two hundred and fifty. The public meeting was held in the University Convocational Hall, which was packed to the limit long before the opening of the meeting. It was necessary to use as well one of the large lecture rooms. This was also filled to capacity and many were turned away. Here, again, every speaker was required to address two audiences. Lieutenant Governor Brett occupied the chair at the evening meeting and did everything possible to assist in making the various sessions successful.

The visiting speakers at Edmonton were Dr. James T. Case, Battle Creek Sanatorium, Battle Creek, Michigan; Dr. Carl A. Hedblom, Rochester, Minnesota; Dr. James B. Eagleson, Seattle, Washington; Dr. H. M. Tory, president of the University of Alberta, Edmonton, Alberta; Dr. Malcolm T. MacEachern, Chicago; Rev. C. B. Moulinier, S.J., Milwaukee; and Dr. Allan Craig, Chicago.

Clinics and clinical demonstrations were held at the local hospitals and were all well attended. The scientific session on the second afternoon held at the MacDonald Hotel, was well attended and was very interesting and instructive. The thanks of the College are due to the local com-

mittee and Fellows of the College in Edmonton for their work in making the meeting successful.

On the way south from Edmonton to Great Falls, the visiting speakers stopped at Calgary, where they were entertained by the local Fellows of the College and other members of the profession and took part in a scientific session at the Holy Cross Hospital.

MONTANA–NORTH DAKOTA

The Montana and North Dakota Sectional Meeting was held at Great Falls, September 18 and 19. Headquarters and registration rooms were at the Rainbow Hotel. The various sessions were conducted in the Grand Theater.

The hospital meeting on the afternoon of the first day was well attended. The public meeting drew an audience of eleven hundred.

The following were the visiting speakers: Dr. James T. Case, Battle Creek Sanatorium, Battle Creek, Michigan; Dr. Carl Hedblom, Rochester, Minnesota; Dr. James B. Eagleson, Seattle, Washington; Dr. Malcolm T. MacEachern, Chicago; Rev. C. B. Moulinier, S.J., Milwaukee; and Dr. Allan Craig, Chicago.

During the program a very delightful violin solo was rendered by Mr. Henry Dotseth of Great Falls, Montana. The address of welcome was given by Mayor H. B. Mitchell. Following the program a moving picture, "The Reward of Courage," was shown. Clinics and clinical demonstrations were given at all the city hospitals and were well attended. The scientific meeting which was held on the afternoon of the second day drew an attendance of one hundred and twenty-five.

The thanks of the College are due to the local Fellows and the members of the Committee who successfully carried on the arrangements for the various sessions.

OREGON–IDAHO

The Oregon and Idaho Sectional Meeting was held in Portland, September 24 and 25. Headquarters and registration rooms were at the Portland Hotel.

The hospital meeting on the first afternoon drew an attendance of three hundred and fifty and the program was enthusiastically received.

The visiting speakers were Dr. James T. Case, Battle Creek Sanatorium, Battle Creek, Michigan; Dr. Dennis Crile, Chicago; Rev. Mark A. Matthew, Seattle, Washington; Rev. C. B. Moulinier, S.J., Milwaukee; Dr. Malcolm T. MacEachern, Chicago; and Dr. Allan Craig, Chicago.

The public meeting was held in the City Auditorium and was the largest which the College has ever had. Although the weather was very unfavorable, the attendance numbered over five thousand. This meeting without doubt broke all the records for public meetings in connection with the sectional meetings of the American College of Surgeons. Too much credit cannot be given to the local committee and especially to those who conducted the publicity.

Clinics were held in local hospitals and the scientific meeting on the second afternoon had an attendance of two hundred. Altogether the Portland Sectional Meeting was one of the most successful which the College has had.

WASHINGTON–BRITISH COLUMBIA

The Washington and British Columbia Sectional Meeting was held at Victoria, B.C., on September 28 and 29. Headquarters and registration rooms were at the Empress Hotel.

The hospital meeting on the first afternoon was crowded. The public meeting was held in the Ball Room of the Empress Hotel. Long before the time for the meeting to begin the auditorium was crowded and there was standing room only. Many were turned away.

The visiting speakers were Dr. James T. Case, Battle Creek Sanatorium, Battle Creek, Michigan; Dr. R. C. Coffey, Portland, Oregon; Dr. Malcolm T. MacEachern, Chicago; Rev. C. B. Moulinier, S.J., Milwaukee; and Dr. Allan Craig, Chicago. The Lieutenant Governor of the proince delivered the address of welcome.

Following the usual program, which was one of the most interesting and enthusiastic of the western group, a moving picture film, "The Reward of Courage," was shown.

Clinics and clinical demonstrations were conducted at the city hospitals on both days. The scientific meeting held on the second afternoon was well attended. Everyone was enthusiastic in the praise of the meetings held in Victoria, and our sincere thanks and appreciation are due to the energetic efforts of the local committee who made them so successful.

UTAH–COLORADO–WYOMING–ARIZONA

The Utah, Colorado, Wyoming, and Arizona Sectional Meeting was held in Denver on October 4 and 5. Headquarters and registration rooms were at the Brown Palace Hotel.

The visiting speakers were Dr. Major G. Seelig, St. Louis, Missouri; Dr. James T. Case, Battle Creek Sanatorium, Battle Creek, Michigan; Dr. Malcolm T. MacEachern, Chicago:

Rev. C. B. Moulinier, S.J., Milwaukee; and Dr. Allan Craig, Chicago.

The hospital meeting had an attendance of three hundred and twenty-five. The public meeting was held in the City Auditorium. Mr. Tyson Dines, of Denver, presided.

Besides the visiting speakers, Rev. Dean D. H. Browne, Rev. Father Hugh L. McMenamin, and Rabbi W. S. Friedman, of Denver, delivered short and interesting addresses. The scientific meeting was held at the Brown Palace Hotel on the second afternoon. As an addition to the surgical program of this meeting, Dr. Finney, of Colorado Springs, gave interesting and instructive addresses on the use of insulin. Everyone was convinced that it was a decided benefit to have a physician on the program and that the custom should frequently be followed up.

Clinics and clinical demonstrations were held in local hospitals.

The thanks of the College are due to the local committee for their energetic efforts.

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